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AMERICAN
DYESTUFF REPORTER

Devoted to Textile Chemistry
BLEACHING • DYEING • PRINTING • FINISHING

AATCC

OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

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Proceedings of the
American Association of Textile Chemists and Colorists

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Editor of Proceedings: Carl Z Draves, 30 Lahey St, New Hyde Park, N Y

MARCH 1, 1954

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CALENDAR

AATCC

COUNCIL

1954—Apr 30 (Atlantic City), June 15, Sept 15, Nov 19.
1955—Jan 21, Apr 15, June 17

NATIONAL CONVENTIONS

Sept 15-18, 1954 (Atlanta Biltmore, Atlanta, Ga); Sept 21-23, 1955 (Chalfonte-Haddon Hall, Atlantic City, N J; 1956 (New York); 1957 (Boston).

HUDSON-MOHAWK SECTION

March 5; April 9, May 14 (Albany); June 18 (Outing).

MID-WEST SECTION

June 11-13 (Annual Outing—Lake Lawn Lodge, Delavan, Wis).

NEW YORK SECTION

April 9, May 14 (Swiss Chalet); June 18 (Outing, North Jersey Country Club, Wayne, N J).

NORTHERN NEW ENGLAND SECTION

Apr 9 (Lowell Tech, Lowell, Mass); June 11 (Outing—Merrimack Valley C C, Methuen, Mass); Oct 8 (Colonial C C, Lynnfield, Mass); Dec 10 (Woodland Golf Club, Auburndale, Mass).

PIEDMONT SECTION

Apr 10 (Hotel Roanoke, Roanoke, Va); June 11-12 (Outing, Mayview Manor, Blowing Rock, N C); Sept 11 (Hotel Barringer, Charlotte, N C).

PHILADELPHIA SECTION

Apr 9 (Kugler's Restaurant, Philadelphia, Pa); May 21 (Outing—Manufacturers Golf & Country Club, Oreland, Pa); Sept 24, Oct 29 (Penn-Sherwood Hotel, Philadelphia, Pa); Dec 3 (Kugler's).

RHODE ISLAND SECTION

Mar 25 (Prov Eng Soc); Apr 29 (Wannamoisett Country Club, Rumford, R I); June 11 (Outing—Wannamoisett C C); Oct 14 (Johnson's); Dec 2 (Annual Meeting—Sheraton Biltmore, Providence, R I).

SOUTH CENTRAL SECTION

April 24 (Hotel Patten, Chattanooga, Tenn); June 4-5 (Summer Outing—Chattanooga Golf and Country Club); Dec 4 (Hotel Patten, Chattanooga).

SOUTHEASTERN SECTION

Mar 27 (Ralston Hotel, Columbus, Ga); May 14-15 (Outing—Radium Springs, Ga); Dec 11 (Atlanta-Biltmore, Atlanta, Ga).

WASHINGTON SECTION

Mar 5 (Textile Museum, Washington, D C).

WESTERN NEW ENGLAND SECTION

Mar 19 (Rapp's Restaurant, Shelton, Conn); May 14 (Ladies Night—Waverly Inn, Cheshire, Conn); June 18; Oct 1, Nov 12, Dec 10 (Rapp's).

Change in Date of Research Symposium

THE all-day Research Symposium previously scheduled for May 4th at the Hotel Statler, New York, will now be held on May 19th. Details of the program will be announced shortly.

EMPLOYMENT REGISTER

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the Secretary.

54-1

Education: high school, and college courses in business administration and chemistry.

Experience: superintendent of dyeing, bleaching and finishing, cotton and rayon.

Age: 37; married; references; position as superintendent, or in technical sales, in South, preferred.

2-15, 3-1

54-2

Education: B S, textile chemistry & dyeing.

Experience: research, development, and application in synthetic fibers.

Age: 28; single; references; position in technical service desired, development or sales, Southeast preferred but not essential.

2-15, 3-1

54-3

Education: B S, textile chemistry & dyeing.

Experience: textile chemist, laboratory and plant.

Age: 24; single; references; technical work in dyeing, printing or finishing desired, New York or Philadelphia area preferred but not essential.

3-1, 3-15

Buttons bearing the insignia of the AATCC are now available from the Secretary at a new price of $2.25. Pins, with safety clasp, are also available at $2.50 each. Write directly to H C Chapin, AATCC Secretary, Lowell Technological Institute, Lowell, Mass.

Membership Cards

Membership cards have now been mailed to all members who have paid their dues. Any member not receiving his card within two weeks of payment should notify the Secretary:

Dr H C Chapin, Secretary
American Association of
Textile Chemists and Colorists
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THE APPLICATION OF VAT DYES

Monograph No. 2 of the

American Association of Textile Chemists and Colorists

"The group of fifteen editors responsible for this monograph consists of a well-balanced cross-section of American industry concerned with the production, marketing and application of vat dyes. The AATCC is to be congratulated on the production of a comprehensive survey of American vat dyeing and printing practice which is the major theme of this application . . . the book will be useful as a work of reference at this side of the Atlantic and as a working manual for the American colorists for whom it was designed. . . . If a clear account of American practice is required . . . the enquirer *must* have access to this volume".—*JOURNAL OF THE TEXTILE INSTITUTE* (England).

"This book . . . is abreast of the latest technical developments and research. Its value is increased because of the lack of books in this field today . . . we can readily recommend this book to all technical and practical men".—*MELLIAND TEXTILBERICHTE* (Germany).

"This monograph contains the work of many mill-experienced authors, plus good, sound chemical and application principles developed in the laboratories and mills enjoying AATCC membership. . . . This book puts between two covers much information that a dyer is constantly searching for. It is a good investment for any laboratory, dyehouse, or printshop."—*TEXTILE WORLD*.

". . . this monograph should be in the hands of every user of vat dyestuffs, every student and every teacher. The book is well indexed and includes valuable lists of equivalent trade names. It will certainly take its place as a standard book of reference".—*JOURNAL OF THE SOCIETY OF DYERS AND COLOURISTS* (England).

The price of "The Application of Vat Dyes" is $5 per copy, postpaid, to members; to nonmembers it is $6 per copy. Send your check or money order to the

SECRETARY
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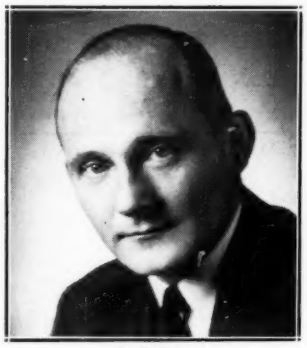
ASSOCIATION OF
TEXTILE CHEMISTS
AND COLORISTS

P O BOX 28, LOWELL, MASSACHUSETTS

Frey Appointed as New Administrative Assistant

RICHARD R FREY of Mount Vernon, N Y, has been named to fill the newly created post of assistant secretary of the AATCC with a view towards increased service to the industry at large as well as the association membership.

Mr Frey's education in the schools of Mount Vernon has been supplemented by extension courses in textile technology at Columbia University. For seven years he was with E I du Pont de Nemours & Co, Inc, in the Fabric Development and Sales Promotion Departments of the Acetate Rayon Division. Mr Frey was engaged in exposition activities prior to the Second World War, before joining the United States Testing Company, Hoboken, N J, where he checked war commodities for conformance with government specifications. He returned to exposition activities following the war, concerning himself with the management of the Grand Central Palace in New York as well as with Campbell-Fairbanks, the firm which has handled a number of AATCC Convention Expositions.



R R Frey

For some time there has been considerable discussion in the Council relative to reorganization plans. The mounting membership, the broadening and increased depth of the research program, the growth of interest at the local section level, the more complicated convention arrangements have developed additional administrative demands beyond the capacity of one secretary. Studies by the President's Advisory Committee have led to the formation of this new position.

MEMBERSHIP APPLICATIONS

February 12, 1954

SENIOR

Ernest W Anderson—Textile chemist, U S Testing Co, Inc, Hoboken, N J. Sponsors: C A Baker, G D Maynard, Jr.

William H Bass, Jr—Supervisor of lab, Standard-Coosa-Thatcher Co, Chattanooga, Tenn. Sponsors: J C Whitt, W D Blackman, Jr.

Harold F Brinkley—Beam dyeing, Avondale Mills, Sylacauga, Ala. Sponsors: W E Fayssoux, G L Dozier.

Herman B Childers—Salesman & technical service, Amalgamated Chem Corp, Greensboro, N C. Sponsors: R A Bruce, H B Dohner.

David G David—Supervisor, Physical & Chemical Testing Service, Alexander Smith, Inc, Yonkers, N Y. Sponsors: E C Hansen, E A Leonard.

Roger H Dickinson—Plant manager, Coats & Clark, Inc, Albany, Ga. Sponsors: R B Hallowell, H I Bashlow.

Parker T Fernald—Textile sales development, Industrial Chem Dept, Atlas Powder Co, Wilmington, Del. Sponsors: R D Fine, B P Devins.

Alfred E Guidotti—Superintendent, Bachman Uxbridge Worsted Corp, Cedartown Textiles Division, Cedartown, Ga. Sponsors: R K Federal, H W Berry.

Norman P Hubbs, Jr—Assistant chemist, Joseph Bancroft & Sons Co, Rockford, Del. Sponsors: R C Squier, G A Billingsley.

Hideo Kasuga—Lab engineering, Tsushima Dyeing & Finishing Co, Saoricho, Japan. Sponsors: G G Neisser, C Z Draves.

Helen W Kendall—Associate editor, Good Housekeeping Magazine, New York, N Y. Sponsors: C W Dorn, J F Warner.

George S Klev—Textile colorist, General Dyestuff Corp, New York, N Y. Sponsors: E M Taylor, H Halvorsen.

James F Lenney—Head, Enzyme Dept, Fleischmann Lab, Standard Brands Inc, Stamford, Conn. Sponsors: S Redfern, H L Jenkins.

Fred Loibl, Jr—Research chemist, Nat Inst of Drycleaning, Silver Spring, Md. Sponsors: R T Graham, E R Clark.

Alfred Marzocchi—Mgr, Chem Lab of Textile Research & Dev Lab, Owens-Corning Fiberglas Corp, Ashton, R I. Sponsors: R F Caroselli, R K Gagnon.

Harold K Massengill—Supervisor, dyestuff control, Research Dept, Dan River Mills, Danville, Va. Sponsors: H M Chase, P B Stam.

Michio Matsui—Supt of Dyeing & Weaving Dept, Kurashiki Cotton Spinning Co, Tsu Woolen & Worsted Textile Mill, Tsu City, Japan. Sponsors: G G Neisser, C Z Draves.

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William Postman — Assistant professor, Georgia Inst of Tech, Atlanta, Ga. Sponsors: J L Taylor, H A Dickert.

William G Rogers—Textile colorist, E I du Pont de Nemours & Co, Inc, Atlanta, Ga. Sponsor: A B Owens.

Jason M Salsbury—Group leader—textile chem, American Cyanamid Co, Stamford, Conn. Sponsors: E A Vitalis, N J Glade.

Joseph R Savnik—Colorist, Imperial Rug Mills, Oakland, Calif. Sponsors: J P Ploubides, R M Lesh.

Anthony Scarmazzo—Head dyer & partner, Mylan Finishing Co, Paterson, N J. Sponsors: E H Staab, H Levitt.

Marvin Schwartz—Chemist, Nat'l Institute of Drycleaning, Silver Spring, Md. Sponsors: R T Graham, E R Clark.

Arnold Staedeli — Dyer, Lee Dye Co, Johnstown, N Y. Sponsors: M Fishman, N Pratt.

Seiichi Takashima—Research Section, Soto Korgo Co, Ltd, Okoshi-machi, Japan. Sponsors: G G Neisser, C Z Draves.

Yuzuru Yamanoto — Director, Chuo Woolen Textile Co, Hirokoji-dori, Japan. Sponsors: G G Neisser, C Z Draves.

JUNIOR

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Ramon L Espinosa—Chemist & colorist, Proquindus, Santiago, Chile.

Guillermo E Ehrhard—Chemist, Tinto-

(Concluded on Page P140)

178TH MEETING—TECHNICAL COMMITTEE ON RESEARCH

THE 178th meeting of the Technical Committee on Research was held at the Hotel Plaza, New York, N Y, on Friday, January 22, 1954. TCR chairman Charles W Dorn called the meeting to order at 1:42 p m.

REPORT ON THE PERKIN CENTENNIAL

The first order of business was a report by Raymond W Jacoby on the arrangements now being made for the Perkin Centennial Convention during the week of September 10, 1956. He outlined the general proposed organization of the Convention Week and stated that it is planned to publish proceedings of the technical sessions, copies of which will be furnished by mail to registrants as soon as possible after the close of the Convention.

REPORT OF THE ECR CHAIRMAN

Leonard S Little, chairman of the Executive Committee on Research, reported on ECR activities, following mention of the necessity for correcting a statement which appeared in the Research Newsletter of January 4 [cf *Am Dyestuff Reptr 42,* No 1, P2 (1954)]. The Newsletter referred to a meeting which was held to organize a proposed industry meeting on May 19, 1954, and the names given in the statement included only the New York group which was exploring the idea, not the complete committee.

Mr Little cited the general interest in the textile industry on the subject of flammability and called for AATCC to refrain from setting specifications for fabrics or attempting to classify them. He urged the Association to be more concerned with setting up the test and assisting people in its use.

AATCC has not had an official announcement of the International Standards Organization meeting, tentatively set for June in England. Mr Little expressed the opinion that, unless there is notification shortly, there probably will not be sufficient time to organize the necessary material.

The National Retail Dry Goods Association has elected to extend its standard tests to all fibers. Thus far the standard tests have covered acetate and rayon.

With reference to sectional advisory research committees, Eugene W K Schwarz has been asked to attempt to extend to other sections the interest that he was able to arouse in the New York Section.

C A Sylvester has been elected a member of the ECR succeeding William D Appel, whose term has expired.

REPORT OF THE TCR CHAIRMAN

Mr Dorn reported a continuing increase of interest in the effects of tumble drying on the shrinkage of fabrics. A subcommittee under the chairmanship of John Warner has been formed to study this problem as well as that of the shrinkage of resin-treated cottons.

As a result of the January 22nd meeting of the FTC Industry Advisory Committee it appears that AATCC will not be called upon to store fabrics involved in an FTC study of flammability, as had been previously indicated.

It will be necessary to appoint a new chairman of the Wool Securing Committee, subject to the Committee's recommendations, it was reported. It was further reported that the Committee on Chemical Technology of Wool, of which John H Skinkle is chairman, may be made a reference committee. Herbert G Scull has resigned as chairman of the Gas Fading Committee and a new chairman will be announced shortly.

REPORT OF THE DIRECTOR OF RESEARCH

Harold W Stiegler, director of research, requested committee chairman to advise him as soon as possible of their plans for holding committee meetings in Atlantic City in April. He also requested that notices of sectional meetings be sent to him at Lowell.

Facilities have been set up at Lowell to store fabrics submitted by Intersectional Contest Committees. It is considered a good idea for all committees to store fabrics, especially if they are considered to be sufficiently worthwhile, so as to be available for later work.

AATCC now has a good stock of all the gray scales (a tentative alternate method) available at $3.00 a set. A notice of their availability was suggested for the *1954 Technical Manual and Year Book.*

Wanskuck Company has prepared two pounds each of the colored primaries of wool rawstock, which will be involved in the preparation of the new light blue exposure standards. These are being sent to Frank J Rizzo of the Philadelphia Quartermaster Research and Development Laboratories for inspection and approval.

AATCC was represented at a recent meeting of ASA Committee L24, the American Hotel Association and the American Hospital Association. These organizations are in the process of drawing up specifications based on AATCC test methods covering utility fabrics, furnishing fabrics, work clothes and uniforms. They are also interested in shrinkage and stretch problems with glass curtains. The dynamic dimensional change meter has been suggested as a suitable instrument for control purposes.

On the so-called Philadelphia Project, progress is being made on high-temperature dyeing including the effect on high temperatures on the fibers. A Venango machine is in use. So far most of the work has been done on wool but will ultimately include other fibers. Temperatures involved are 205°, 225° and 250°F, and time intervals are 15, 30, and 45 minutes and one hour.

Further progress was reported on the work being done under the American Viscose Fellowship on the rapid method for determining shrinkage of rayon fabrics.

The Lowell organization is working with the Standard Soils Committee with particular reference to the newer fibers. It is also doing further work on flammability and reports that there seems to be little need to worry about flammability of wool in the work done so far. Under study is the matter of flammability after laundering and drycleaning, which is placing considerable emphasis on standard drycleaning test methods.

The new Inconel Launder-Ometer tubes are being found useful in other tests than the detergency test for which they were originally developed.

Further work is being done by the Water Repellency Committee on allied problems.

The work at Lowell on the gas fading of vat dyed cotton fabrics indicates that some of these colors will change if the exposure is long enough or the temperature of the exposure is high enough. However, in general there seems to be no particular problem indicated and although more than a year has elapsed there are no further reports of additional complaints on this matter.

In connection with the Accelerotor, AATCC has had an official trade mark allowed. Further work is being done comparing Accelerotor results with commercial laundering, particularly for shirting materials, combining the effects of both wear and laundering motion on coated fabrics, flock prints and knit goods. Studies are being conducted on weight loss after abrasion, edge wear at seams and the effects of alternate wearing and washing. Experience indicates the advantage of having AATCC observers present

while industry runs are being made in order that more complete data may be secured, particularly with commercial laundry or dry cleaning runs.

Dr Stiegler requested that all members of the committee who receive ballots for voting on proposed tests be punctilious about returning their ballots as promptly as possible. He urged that, if a person is not interested in the field represented by a test or does not feel qualified to make an intelligent vote, he nevertheless should return the ballot with the indication that he does not prefer to vote. While returns on the recent ballots have been fair, they could and should be better.

Dr Stiegler referred to a request from an insurance company for a method to determine the dermatitis propensities of textile materials. This was not considered a subject for which the Association should be responsible for the development of tests. It was felt that, being a medical subject, it should be worked on by qualified personnel, although the Association is quite willing to cooperate with any medical group.

REPORTS OF SUBCOMMITTEE CHAIRMEN

SUBCOMMITTEE ON FASTNESS TO LIGHT———M J Babey, outgoing chairman and present secretary, reported that this committee is providing some fluorescent tubing for fading studies. The revision of the test method has been approved as written by the Steering Committee. A report by Frank J Rizzo on the blue standard wool stock samples which were submitted to him by the Wanskuck Company will allow the Company to proceed with the first phase of the production. If all goes well with the standard a finished fabric form should be available for inter-laboratory testing by approximately May 1, 1954.

SUBCOMMITTEE ON STANDARD DEPTH OF SHADE———M J Babey, chairman, reported that this committee has agreed on the following points:

1) The principle of standard depths is acceptable.

2) The 12 shades submitted by the Europeans seem to be satisfactory.

Spectrophotometric readings on each will be made before a definite decision is reached. In progress is a laboratory survey of twenty dyes of different hues within the proposed standard depths. The purpose is to determine how closely skilled technicians will agree when comparing dyes of various hues to the standard depths. A copy of this report is to go to W H Cady for transmission to our British partners for the *Colour Index*. I H Godlove commented on the shades which are going to be evaluated spectrophotometrically and referred to a paper which he has prepared for publication which may be somewhat in conflict with recommendations of the Standard Depth Committee. A decision on publishing this paper will be reached shortly. Dr Godlove also referred to an English comment on a recent article written by him and stated that he would prefer that the committee, rather than he as an individual, reply. This will be followed.

SUBCOMMITTEE ON BLEACHING ———In the absence of the chairman, R A Secord, the secretary of the subcommittee reported that a draft of a proposed report has been circulated to the committee and is expected to be in final form at the April meeting. In connection with color fastness to chlorine bleaching and color fastness to peroxide bleaching, the committee has reviewed methods and is preparing a report for the next meeting. It is also studying a so-called wetability test identified as 39-52.

SUBCOMMITTEE ON STOVING ———W A Holst, chairman, reported that preliminary tests have been completed. It has been proposed that the standards for dyed cotton and silk be eliminated and the three topchromed dyeings of wool, which have been found to meet the defined requirements of the several qualifications, be adopted. A few small details of a proposed test are under study, which should lead shortly to the recommendation of a new tentative method.

SUBCOMMITTEE ON STREAM POLLUTION———P Theel, Chairman, reported on his activities at a recent Cincinnati meeting of the general Industry Technical Task Committee. He also reported that the Piedmont Section has completed a bibliography, which will be reviewed and published ultimately in six sections in the DYESTUFF REPORTER. He advised that there is provision for Government sponsorship of some of the material developed by the Stream Pollution Committee.

SUBCOMMITTEE ON ABRASION ———M W Winkler, chairman, stated that this committee will join with the ASTM analogous committee. He reported that, in original tests in ten laboratories, no good correlation was found. Further interlaboratory tests have been made, however, and are now showing better agreement as the test is being refined. Further tests are planned including the use of the Accelerotor.

GAS FADING————Mr Dorn asked C A Sylvester for a report on the new supply of gas-fading standards. Mr Sylvester reported that the new chairman of this committee will be named in the near future and will handle this matter. At the request of Mr Dorn, Mr Sylvester also reported on his trip to Cliffside Dyeing Corporation, Paterson, New Jersey. Two days were spent conducting tests with their gas-fume-fading unit. Immediately after the tests were removed from the instrument they showed good agreement with standard tests. After standing, however, they showed considerable progressive fading, which forced the conclusion that, in its present form, the instrument is not good for standard tests. It is probably quite adequate for production control. Dr Meili expressed the opinion that the machine or the procedure could be reviewed to eliminate this difficulty. It is also possible that during the check test period the standard procedure may have been too greatly accelerated. There will be further review on this point. Dr Stiegler will send a copy of Mr Sylvester's formal report to Dr Meili.

C H A Schmitt referred to the fact that changes in test methods are not at the present time emphasized and thus are not generally known officially among industry technologists, consequently they are frequently using methods which are out of date. Upon motion by Mr Schmitt it was concluded that in the next *Year Book* there will be listed, either on the jacket or in some other conspicuous place, methods which are new or which have been radically changed during the preceding year.

There being no further business the meeting adjourned at 3:17 pm.

The next meeting of the Technical Committee on Research will be held at the Hotel Dennis in Atlantic City, April 29-30, during the week of the Textile Machinery Exposition.

Those present at the 178th meeting were: C W Dorn, chairman; H W Stiegler, director of research; G H Schuler, secretary; L S Little, ECR chairman; and M J Babey, K H Barnard, G L Baxter, A T Brainerd, H C Chapin, J N Dalton, S J Davis, H C Donaldson, Jr, C Z Draves, E E Fickett, P J Fynn, I H Godlove, H E Hager, E Hansen, S L Hayes, W A Holst, G H Hotte, R W Jacoby, H Y Jennings, D P Knowland, E W Lawrence, A R Macormac, J E Meili, J E Norton, R D Robinson, A E Sampson, C H A Schmitt, R A Secord, F T Simon, R B Smith, R H Souther, C A Sylvester, P Theel, F Tripp, C A Whitehead, M W Winkler, P J Wood.

AATCC Committee on Stream Pollution——

A COMPARISON OF THE OXYGEN CONSUMED FROM PERMANGANATE AND B O D TESTS IN THE STUDY OF TEXTILE WASTES*

Rhode Island Section Subcommittee on Stream Pollution

HAROLD J NORTHUP, *Secretary*

INTRODUCTION

A QUESTION that sometimes arises is whether the American Public Health Association test methods, which are used for studying the oxygen-absorbing properties of domestic sewage and certain industrial wastes, are applicable to the study of textile wastes, e g, whether it is possible to correlate the more rapid oxygen consumed from permanganate (OC) method with the 5-day biochemical oxygen demand (BOD) tests in trying to effect some control of the working of a trickling filter or other method of waste treatment.

Some work has been done on this problem in the Rhode Island Section, from which it would appear that a BOD/OC factor can be worked out for a given effluent for the purpose of control. This would make possible the use of a quick OC determination and would eliminate the necessity of waiting five days for the BOD test. However, it would also appear that the factor will vary with the type of waste, and it would be up to each plant to work out the factor for its own particular effluent.

OBJECTIVE———The purpose of this report is as follows:

A. A brief study of the two principal methods of measuring the polluting effect on streams of wastes that cause oxygen depletion, viz:

1) Oxygen consumed from permanganate (OC).

2) Biochemical oxygen demand (BOD).

B. A comparison of the relative degree of stream pollution by domestic and textile wastes as determined by these two methods.

OXYGEN CONSUMED FROM PERMANGANATE (OC)

A. DEFINITION ——— The oxygen consumed from permanganate is that amount used by a sample when digested for a definite length of time at a definite temperature with a definite concentration of acidic or alkaline permanganate.

B. VARIATION IN CONDITIONS USED———

1) Common British Procedure for sewage.

a) Sample is treated with acidic N/80 permanganate for 4 hours at 80°F (26.7°C) *(1)*.

2) American practice for sewage.

a) Massachusetts Department of Public Health Method:

i Sample is boiled for 5 minutes with acidic N/80 permanganate.

b) American Public Health Association Methods (APHA) *(2a)*:

i Sample is digested with permanganate solution for 30 minutes in a boiling water bath.

ii Details of methods *(2b)*:

a. For normal sewage effluents and polluted waters, use N/80 acidic $KMnO_4$.

b. For brines or waters high in chloride, use N/80 alkaline $KMnO_4$.

c. For strong sewage, use N/8 acidic $KMnO_4$.

3) Industrial Wastes.

a) The OC has been obtained by the APHA method for strong sewage (N/8 $KMnO_4$, 30 minutes, boiling water bath) *(3)*.

i Higher results are usually obtained with the stronger permanganate solution because of its greater oxidizing capacity *(2b)*.

ii "On oxidized effluents the stronger permanganate oxidizes more of the stable organic matter and gives results many times greater than the BOD" *(Ibid)*.

iii "On some wastes and digested liquors the results will be lower, rather than higher" than the BOD *(Ibid)*.

b) The other conditions for determining OC listed above for sewage are also used for wastes.

c) The final OC results are controlled by

i The concentration of permanganate.

ii The concentration of acid or alkali.

iii The time of digestion.

iv The temperature of digestion *(2c)*.

d) This should be considered in comparing OC data from different sources and in comparing OC and BOD results.

C. WHAT THE OC TEST INDICATES———

1) The OC test indicates only a part of the carbon in organic matter *(2a)*.

a) The carbon in nitrogenous organic matter is not so readily oxidized as that in carbonaceous organic matter *(Ibid)*.

b) "The test does not directly differentiate the carbon present in unstable organic matter from that in fairly stable organic matter" *(Ibid)*.

2) "Nitrates, ferrous iron, sulfide and other oxidizable substances reduce permanganate; therefore, corrections for them should be made" *(Ibid)*.

D. THE OC TEST IS NOW BEING LARGELY SUPERSEDED BY THE BOD TEST *(4a)*———

1) The OC test "is of value in estimating the strength of certain trade wastes and sewages when the biochemical oxygen demand cannot be determined, or in conjunction with the BOD" *(2c)*.

BIOCHEMICAL OXYGEN DEMAND (BOD)

A. DEFINITION———

1) "The biochemical oxygen demand . . . of sewage, sewage effluents, polluted waters, or industrial wastes is the oxygen (in parts per million) required during stabilization of the decomposable organic matter by aerobic bacterial action" *(2d)*.

2) Since complete stabilization requires more than 100 days at 20°C (68°F), a five-day incubation at 20°C is commonly used and is recommended as the standard procedure *(Ibid)*.

B. PROCEDURE———

1) Details of the procedure for obtaining the 5-day BOD, including the precautions to use in case of the presence of interfering substances, are given in *Standard Methods (2d)*.

* Submitted to the Reporter by the Editor of Proceedings on January 19, 1954.

2) A single dilution technique may also be used *(7)*.

C. IMPORTANCE———

1) The BOD "is considered as the criterion of the strength of a waste and of its power to damage a stream used for potable waters of fishing" *(4b)*.

2) "The BOD of a waste indicates to a certain degree the type and extent of treatment which must be employed to reduce the oxygen-absorbing power to a point where it will not reduce the oxygen content of the stream to a dangerous point" *(Ibid)*.

3) "In spite of . . . imperfections and difficulties, the value for biochemical oxygen demand is probably the best single measure of the strength of an industrial waste for which the polluting effect in a stream, or the difficulty in treatment at a sewage-disposal works, is due to its content of organic matter capable of oxidation by biological activity." *(1)*.

EXPERIMENTAL COMPARISONS

Table I gives a comparison of the OC and BOD of the combined wastes from a) the bleach house and cotton-dyeing plant and b) the synthetic-dyeing plant of Bradford Dyeing Association (USA). Data for domestic sewage are also listed for comparison.

Table II compares the OC and BOD of selected cotton-finishing wastes from Bradford Dyeing Association (USA). These OC tests were made by a procedure different from that used for Table I, as indicated in the tables.

Table III lists the OC and BOD of various concentrated wastes from a cotton-finishing plant in Connecticut *(3)*. The OC tests were made with a permanganate solution which was ten times stronger than that commonly used for ordinary sewage *(2b)*. It will be noted that the OC results are generally higher than the BOD tests, in contrast with most of the data in Table II.

SUMMARY AND CONCLUSIONS

1) The oxygen consumed from permanganate and five-day-biochemical-oxygen-demand tests each have their place in the study of textile wastes.

2) The oxygen-consumed test gives widely differing results, depending on the conditions used; therefore, the reaction time and temperature, and the concentrations of permanganate and acid or alkali should always be noted.

TABLE I

Comparison of Oxygen Consumed from Permanganate and the BOD of Combined Textile Finishing Wastes and of Domestic Sewage (OC Test: N/80 $KMnO_4$, 30 minutes, 100°C)*

Source of Sample	*OC ppm*	*5-Day BOD ppm*
Bleach-house and cotton-dyeing-plant effluent	132	117
Synthetic dyeing plant effluent	134	113
Allentown, Pa, Sewage (5a):		
Raw	129	213
Imhoff-tank effluent	67	84
Trickling-filter effluent	42	35
Raw Sewage, average of 15 US Cities (5b):	45	121
Screened domestic sewage, average of 234 samples: (Illinois) (5c)	25-103 (av, 59.3)	—

* APHA Method for ordinary sewage (2a).

TABLE II

Comparison of Oxygen Consumed from Permanganate and the BOD of Cotton-Finishing Wastes (OC Test: N/80 $KMnO_4$, 5 minutes, b p of Mixture)*

Source of Sample	*OC ppm*	*5-Day BOD ppm*
Singer, desizer	485	1320
Desizing pad	16800	18400
Caustic kier liquor	5900	5005
Sour bath	29	59
Stabilized soluble-vat pad liquor	1883	2266
Vat pad liquor	11340	1800
Jig dyebath	3280	7975
Formaldehyde aftertreat	4800	5300
Soap and ammonia bath	325	4000
Ammonia, bifluoride and synthetic-detergent bath	2000	2103
Naphthol dyeing, pad liquor	27333	2133
Softener bath	520	4567

* Method used by the Massachusetts Department of Public Health.

TABLE III

Comparison of Oxygen Consumed from Permanganate and the BOD of Cotton Finishing Wastes (OC Test: N/8 $KMnO_4$, 30 Minutes, 100°C)*

Type of Sample	*OC ppm*	*5-Day BOD ppm*
Diastatic enzyme and small amount of soap	3320	1748
Kier liquor (average)	14810	8400
Continuous boil-off for grey goods (caustic, soap, little sodium alkylarylsulfonate)	10600	5750
Oxalic Acid, sodium alkylarylsulfonate (stain removal)	1290	493
Soluble oil, vat color	4015	1325
Acetic-acid rinse (average)	918	3050
Continuous vat dyeing (NaOH, $Na_2S_2O_4$, NaCl)	6400	2325
Naphthol dyeing	6150	2275
Deterging bath, soap and soda ash	3000	2820
Print-roll washings	1638	848

* APHA method for strong sewage (2b).

3) In general, the BOD test, although requiring more time and equipment, gives more satisfactory and significant results for studies of stream pollution and waste treatment.

4) The oxygen-consumed test is useful for specific purposes where time is an important factor. For example, periodic oxygen-consumed tests would indicate the failure of a trickling filter more quickly than would the 5-day BOD test.

5) The data in Tables I-III show that some textile wastes have a greater oxygen-absorbing effect per gallon on streams than domestic sewage.

Notes: The 1-day BOD and COD [chemical oxygen demand, oxidation by dichromate (6)] tests are also used for control purposes in the treatment of sewage and industrial wastes when quick check tests are desired.

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(7) Orford, H E, Rand, M C, and Gellman, I, "A Single Dilution Technique for BOD Studies," *Sewage and Ind Wastes* 25, 284-9 (1953).

1953 Annual Convention——
Textile Auxiliaries Group

EMULSION POLYMERS FOR THE TEXTILE INDUSTRY*

LEONARD SHAPIRO

Director, Sales Service Division, American Polymer Company of the Chemical Division of the Borden Co

L Shapiro

A review of the fundamental principles of emulsion polymerization, tracing the effect of the many variables, including copolymer composition, emulsifying system, particle size, effect of these factors on molecular weight, chemical stability, mechanical stability, gloss, washability, etc. Review of applications ranging from emulsifying agents, and warp sizings to finishing agents, pigment binders and nonwoven fabrics.

INTRODUCTION

DURING the past generation, the textile industry has seen an ever-growing trend away from the starch, gelatin, and natural-gum sizings toward synthetic-resin finishes.

Thermoplastic resins have been gaining in popularity, particularly since they have become available in the form of aqueous dispersions. These resins produce improved hand and fullness in "noncuring" finishes and are used as additives in thermosetting resin finishes to improve hand and abrasion-resistance, in binders and sizings for yarns, cords, and nonwoven fabrics, in laminating and combining operations, and as warp sizings.

The thermoplastic resins were first produced as bulk polymers or solvent solutions, and the fact that they had to be handled in nonaqueous systems (often in toxic or flammable solvents) proved to be a serious drawback in textile plants that were equipped only for application from water systems.

As the principles of emulsion polymerization were worked out and placed in mass production, it became possible to adapt many of these polymers to the aqueous applications so familiar to the textile finishing industry.

Thus, it became possible for the finisher to apply, from water systems, resins which dry to form insoluble films without requiring curing and washing operations.

Various resin dispersions are now widely used in the textile industry to enhance the quality, handle, and appearance of all types of fabrics. These dispersions deposit clear, colorless films, which do not alter the shade of dyed and printed fabrics, but enhance their brilliance.

Among the advantages of finishes deposited from aqueous resin dispersions are the following:

1) Complete miscibility with water (equipment may be cleaned with water).
2) "Sets" to form insoluble films on drying (no high-temperature curing is required).
3) Compatibility with anionic and nonionic softeners, surface-active agents, starches, and gums.
4) Excellent adhesion to natural and synthetic fibers.
5) Improved hand, tensile strength, abrasion resistance.
6) Odorless, tasteless, nonyellowing on exposure to heat, ultraviolet rays, or aging.
7) Resistant to removal by laundering or dry cleaning.
8) Resistant to acids, alkalis, grease, and solvents.
9) Freedom from tendering and chlorine absorption on laundering.

* Presented as part of a symposium on textile auxiliaries in the West Ballroom of the Conrad Hilton Hotel in Chicago on Friday, Sept 18, 1953. Submitted to the Reporter by the Editor of Proceedings on December 14, 1953.

POLYMERIZATION

IN EMULSION ——— Emulsion polymerization is based on the emulsification of the liquid monomer by the use of appropriate surface-active agents and protective colloids. The properties of the emulsion, its mechanical stability, particle size, etc depend on the emulsifying agents, type and intensity of agitation, etc.

The catalyst is added, and polymerization is regulated, by control of temperature, pH, concentration, rate of addition, and oxidation-reduction potential, until the reaction is complete. The resulting polymer is now in the form of fine solid particles dispersed in an aqueous medium.

Resin dispersions prepared by emulsion polymerization are generally referred to as *resin emulsions, resin dispersions,* or *latices.* The term *emulsion* is carried over from the *emulsion* polymerization process, and from the fact that the product starts as a *monomer emulsion.* Actually, the *finished* product is a solid resin *dispersion* in an aqueous medium and *resin dispersion* is a more correct designation (but is too broad, since it includes dispersions in organic media, such as organisols, plastisols). The more flexible film-forming resin dispersions are also referred to as *latices* by analogy with natural rubber latex. The writer prefers the term *emulsion polymers,* since it is technically correct and is limited to those resins *polymerized* in emulsion state.

MECHANIZATION OF POLYMERIZATION ——— Emulsion polymerization is a form of addition polymerization which proceeds by the free-radical mechanism. In this process, the vinyl-type monomer is first dispersed so that it exists in the form of a very large number of colloidal particles. In this emulsion the monomer is present in the form of both micelles and droplets.

The reaction initiator is an oxidizing agent (generally a water-soluble type, such as hydrogen peroxide, potassium persulfate, etc). More recently, it has been found that certain reducing agents act as accelerators by forming redox systems. (While the mechanism has not been completely explained, it is possible that the reaction proceeds most rapidly at a definite oxidation-reduction potential, which is critical for each polymerization system).

a) *Initiation of Reaction* ——— Emulsion polymerization reactions are started by formation of a free radical in the aqueous phase. This is caused by decomposition of the initiator, and is illustrated here by benzoyl peroxide:

$$\underset{\text{Peroxide}}{(RCO_2)_2} \xrightarrow{\Delta} \underbrace{2RCO_2\cdot \longrightarrow 2R\cdot}_{\text{Free Radicals}} + 2CO_2\uparrow$$

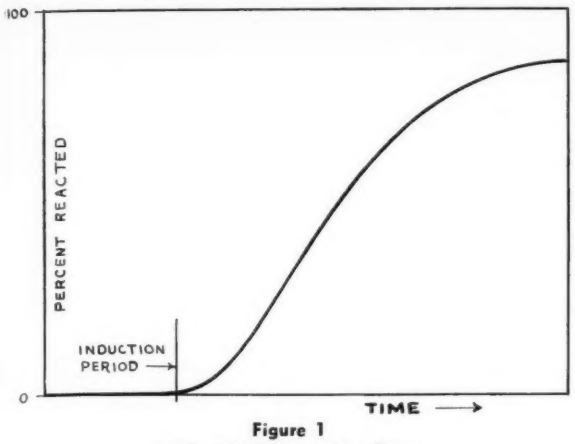

Figure 1
Typical Polymerization Curve

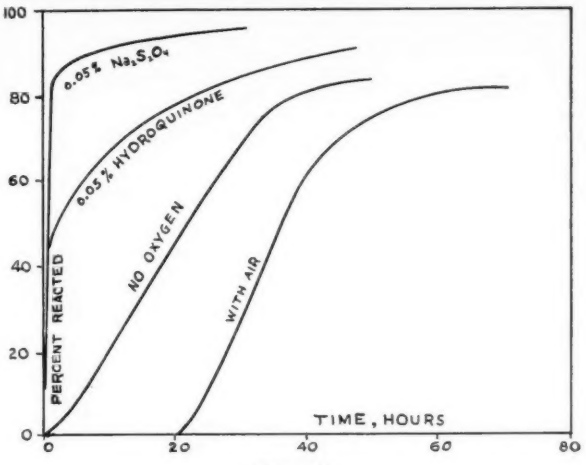

Figure 2
Polymerization of Acrylonitrile—
Effect of Oxygen and Reducing Accelerators
(Bacon—1946)

b) *Propagation of Reaction* ——— A free R. radical reacts with a molecule of monomer in the emulsion to form a new free radical, $R\,CH-CH_2\cdot$ The activated monomer molecule is a new free radical, which combines with another molecule of monomer. This process continues in a very rapid chain reaction until "termination" occurs.

$$R\cdot + CH_2{=}CH_2 \longrightarrow RCH_2{-}CH_2\cdot$$
$$R{-}\{{-}CH_2{-}CH_2{-}\}_x + CH_2{=}CH_2 \longrightarrow R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2\cdot$$

c) *Termination* ——— Chain termination occurs by a number of mechanisms, including the following:

1) *addition of another initiator free radical* at the end of the chain:

$$R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2\cdot + R\cdot \longrightarrow R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2R$$

2) *disproportionation* of two free radical chains to form a saturated and an unsaturated chain:

$$R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2\cdot + \cdot CH_2{-}CH_2{-}\{CH_2{-}CH_2{-}\}_y R \longrightarrow \begin{cases} R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_3 \\ R{-}\{{-}CH_2{-}CH_2{-}\}_y\,CH{=}CH_2 \end{cases}$$

3) *chain transfer,* wherein the free radical undergoes an interchange reaction with a normally stable molecule R'Y (usually a mercaptan or a halogen compound), terminating the chain, and producing a new free radical:

$$R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2\cdot + R'Y \longrightarrow R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2{-}Y + R'\cdot$$
$$+ CCl_4 \longrightarrow R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_2Cl + Cl_3C\cdot$$
$$+ R'SH \longrightarrow R{-}\{{-}CH_2{-}CH_2{-}\}_x\,CH_2{-}CH_3 + R'S\cdot$$

4) by the *addition of two growing chains,* terminating both:

$$R\,CH_2{-}CH_2\cdot + \cdot CH_2{-}CH_2{-}R \rightarrow R\,CH_2{-}CH_2{-}CH_2{-}CH_2R$$

Thus, mercaptans are frequently added to obtain polymers of lower molecular weight, and solution polymers reacted in chlorinated solvents generally have low molecular weights. Impurities in the reactants may also limit molecular weight.

It is interesting to note that, in any individual chain, the free-radical chain reaction is extremely rapid, and probably proceeds from *initiation* to *termination* in a *fraction of a second.* The fact that emulsion polymerizations require many hours, or even days, to attain high conversion is not due to the time required to build up the molecule, but to the time required for initiation of all the polymer molecules. If a larger number of molecules is initiated at the start, then the average molecular weight must obviously be much lower.

In emulsion polymerization with initiators in the water phase, molecular weights are quite high, since initiation ocurs only at a small number of points in the monomer micelle. Under ideal conditions, if only one free radical enters a monomer micelle, the entire micelle could become a single molecular chain (except for the various chain termination mechanisms). Actually, the molecular size is not limited by the micelle dimensions, since fresh monomer continues to reach the micelle by vapor-phase diffusion from the larger emulsion droplets.

REACTION INHIBITORS ——— Certain compounds have been found to inhibit the polymerization reaction. These include hydroquinone, copper salts, diphenylamine, and oxygen. This phenomenon is useful in stabilizing monomers to prevent premature polymerization or in "short-stopping" polymerization to prevent cross-linkage toward the end of the reaction. On the other hand, it can also be quite disturbing, since accidental traces of impurities can hinder progress of the reaction or reduce the molecular-weight.

Reaction *retarders* do not affect the length of the induction period but slow down the conversion reaction (ie, the time for *initiation* of all the polymer molecules).

Reaction *inhibitors* increase the induction time, but do not affect the speed of conversion.

REACTION KINETICS ——— Because of the high speed of the chain reaction, only monomer and polymer are present at any time (not more than a trace of volatile dimers or trimers is likely). This makes it possible to determine the progress of the reaction by comparing the nonvolatile content of the emulsion against the theoretical yield at intervals.

Fig 1 illustrates a typical curve of

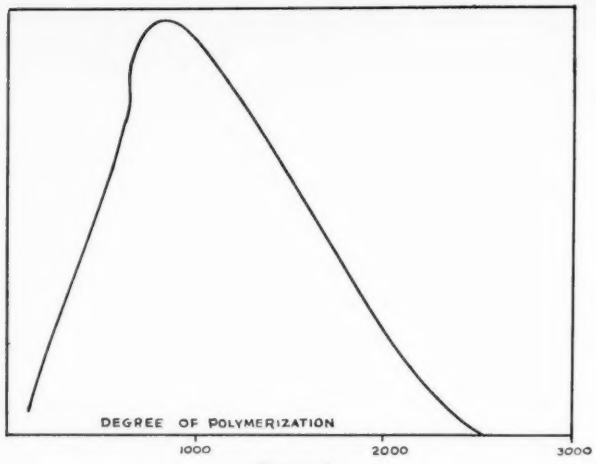

Figure 3
Molecular Distribution of Polystyrene (Schulz—1939)

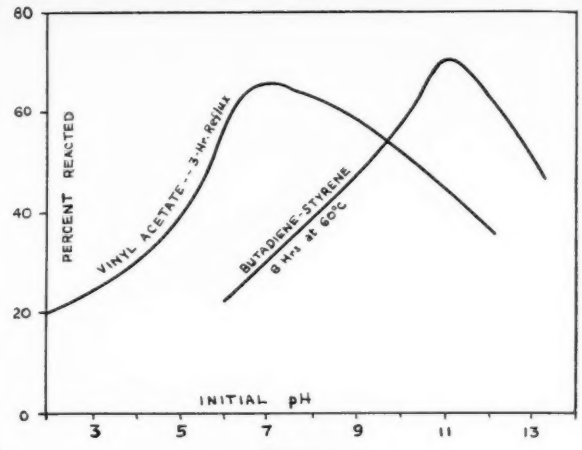

Figure 4
Effect of pH (H Naidus—1953)

time vs percent reacted. The induction period required for initiation of the reaction is particularly interesting.

This induction period has been correlated with the presence of oxygen or inhibitors in the monomer, and may be reduced almost to zero if all oxygen is removed (Fig 2). The addition of reducing-type accelerators shortens the induction period from hours to a few minutes. They do not affect the *rate of polymerization of individual chains,* but they increase the over-all reaction rate *(1)* by decreasing the time required for free-radical activation (Fig 2).

Evidence that chain termination can occur at random intervals is afforded by the familiar molecular-weight distribution curve of Fig 3 *(2)*.

OTHER FACTORS AFFECTING REACTION RATE——It has been found that each emulsion polymerization system appears to have its own optimum pH. H Naidus *(3)* shows a peak reaction speed at pH 7 for a vinyl acetate emulsion system, while a particular butadiene-styrene emulsion system shows a peak at pH 11 (Fig 4).

Rate of agitation has an effect more striking than in most chemical reactions. Some agitation is required to prevent agglomeration and settling as well as to provide rapid heat transfer. High-speed agitation, however, may *lengthen* the induction period and cause faster consumption of modifiers.

CROSS-LINKING —— Monomers containing only one double bond give rise to linear polymers and line up in "head-to-tail" configuration. Addition of even a trace of monomer having *two double bonds* (eg divinylbenzene, butadiene) causes chain-branching or cross-linkage between chains, and the cross-linked polymer is much more resistant to heat, solvents, etc. This is illustrated in Fig 5 with polystyrene cross-linked by divinylbenzene.

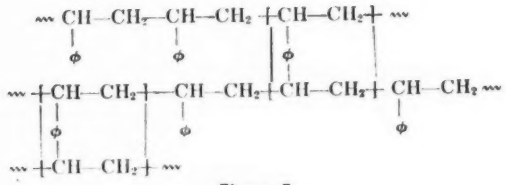

Figure 5

COPOLYMERIZATION —— Copolymerization, which consists in polymerizing a mixture of two or more monomers to yield a polymer containing both, is by no means as simple as it appears at first glance. Two monomers seldom react at equal rates, and the resulting polymer may vary in composition from the start to the finish of the reaction.

In addition to copolymerization rate differences (which may have no relation at all to homopolymerization rates), several phenomena occur which are not predictable from homopolymerization. For example, vinyl acetate and styrene, both of which polymerize readily by themselves, have an inhibiting effect on each other and cannot be copolymerized at all. On the other hand, maleic anhydride does not normally polymerize by itself but copolymerizes with styrene.

In order to avoid changes in polymer composition throughout the run, the more reactive of the monomers is frequently added slowly throughout the reaction.

EMULSION POLYMERIZATION TECHNOLOGY —— Some polymerization systems lend themselves readily to the simple technique of merely emulsifying the monomer, adding catalyst, heating, and maintaining at reaction temperature until the reaction is carried out to the desired degree. Other polymerizations require special techniques to control the reaction rate or to keep the copolymer composition uniform throughout the run.

The simple *batch process* is frequently useful and requires the simplest equipment setup. It is important, in this method, to determine in advance whether the heat liberation can be controlled, since runaway polymerization reactions can be very hazardous. The importance of installing every possible precaution and safety device, particularly for this type of reaction, can hardly be overestimated.

The *monomer-addition* method (ie, continuous addition of one monomer during the reaction) is used to control very exothermic reactions, to obtain copolymers of uniform composition, and to obtain finer-particle-size emulsions, higher solids, etc.

In the *emulsion-addition* system, a small amount of water, emulsifier and initiator are added to the vessel at the start, and a monomer emulsion is prepared separately and run into the kettle throughout the course of the reaction together with addition catalysts.

A continuous process has been worked out, in which the emulsion addition tech-

nique is combined with continuous withdrawal of the finished product from the reactor.

MECHANISM OF FILM FORMATION ——One of the astonishing properties of many emulsion polymers is that, despite the fact that they are dispersions of *solid* resin particles, these particles *merge on drying to form a continuous film.*

Not all the factors involved in this mechanism have been investigated; however, Henson, Taber, and Bradford *(4)* have shown that two stages are involved:

1) Irreversible contact between particles on evaporation of sufficient water.
2) Fusion of the particles.

Stage 1 was shown, in the case of one polymer dispersion, to occur after evaporation of water to about 67% solids to bring the emulsion particles in contact with each other. This is irreversible and is measured by the fact that solids no longer wash out of the film readily.

Combination of the resin particles was shown by the above authors to be caused by surface tension in the water pockets between particles. In a latex having a particle size of 0.2 micron the holes between particles are about 0.04 micron and the pressure developed between particles amounts to 435 lb/sq in. Resin particles which undergo cold flow at 435 lb/sq in merge readily to form strong, clear films (eg polyvinyl acetates, certain acrylics, plasticized polystyrenes).

In Stage 2, once the particles are in contact, they are forced together by the surface tension of the resin itself, causing the particles to undergo viscous flow. Smaller particles fuse more completely than larger particles.

The very hard polymethacrylic, polystyrene and polyvinyl chloride resins do not fuse at the above pressures at room temperature, but a film can be formed if drying takes place at elevated temperatures.

Resins too hard to fuse at room temperature dry to a powder. If these products are plasticized so as to lower the fusion temperature (by addition of suitable plasticizers or soft, compatible resins), continuous films may be deposited at room temperature.

On the other hand, a drop in application temperatures may be responsible for loss of film-forming properties. Thus, polyvinyl acetates, which form films readily at ordinary temperatures, dry to a powder at 40°F—a factor which merits serious consideration in the use of polyvinyl acetate-based wood-glues on cold stock, or in painting with emulsion paints on cold surfaces.

The incorporation of plasticizer permits film formation at lower temperatures. If further plasticization is undesirable, volatile solvents which evaporate more slowly than water can be employed to soften the resin enough to allow film formation and adequate adhesion. The solvent, having accomplished its work, evaporates, leaving a coherent film behind.

PLASTICIZATION OF EMULSIONS ——The plasticizing of polyvinyl acetate emulsions is also a little more complicated than is generally realized, and a knowledge of the mechanism is essential to the compounder of resin emulsions. Plasticizing may be accomplished by any of the following methods:

1) *"Integral" plasticization*——Here the plasticizer is dissolved in the monomer, and the resulting solution is polymerized by conventional methods in a solution or emulsion form. When the plasticizer is a saturated monomeric type, the advantage is only one of convenience, since no chemical reaction is possible.

On the other hand, since the presence of other compounds may affect polymerization, and since the manufacturer cannot guess which plasticizer the consumer will wish to use, *postplasticization* is generally preferred.

2) *Postplasticization*——This is accomplished by emulsifying an active plasticizer directly into the water phase of the resin dispersion after polymerization is complete. Certain polyvinyl acetate emulsion systems are so balanced that plasticizers may be stirred in and will emulsify after thorough agitation. For most other resin emulsions, however, it is necessary to emulsify the plasticizer first (in a system compatible with the resin emulsion) and then to stir the plasticizer emulsion into the resin dispersion. This results in a mixed emulsion having both emulsifier particles and resin particles, each surrounded by films of protective colloid or surface-active agent, and of the same electrostatic charge.

Under these stable emulsion conditions, plasticizer globules cannot come in direct contact with the resin particles. Nevertheless, certain plasticizers, after adequate aging or "ripening", disappear completely as a separate emulsion phase. The "ripened" emulsion then contains only uniformly plasticized resin particles. The transfer from the plasticizer globule to the resin particle occurs primarily by *diffusion through the water phase.*

The rate at which plasticizers diffuse through the water phase depends on a number of factors, including *diffusivity* of the plasticizer molecules, *solubility* in the water and resin phases, *temperature* of the emulsion, *particle size,* and *rate of agitation.* Also important is the rate at which the plasticizer diffuses into the resin particle. Thus, the ability of the plasticizer to dissolve in or swell the resin is important and may even be the controlling factor. The addition of a volatile solvent may speed the process by acting as a mutual solvent for the resin and the plasticizer. Fine particle size, high temperature, and rapid agitation all help speed the "ripening process".

With softer resins, such as polyvinyl acetate, plasticizer seems to be incorporated almost immediately, since clear films are deposited without aging; however, optimum film properties are not obtained until the emulsion is aged about 24 hours at room temperature or 1 to 2 hours at 50 to 60°C (122-140°F). With harder resins, such as polyvinyl chloride, clear continuous films are not obtained until virtually all the plasticizer has diffused into the resin particles.

The following data for absorption of 15% plasticizer (added in the form of a 50% emulsion) to a vinyl chloride copolymer (in the form of a 56% latex) at room temperature illustrate these principles *(5):*

Plasticizer	*Days for Absorption*
Triethylene glycol di(2-ethylbutyrate)	0
2-Ethylhexyl adipate	4
Dioctyl phthalate	23
Butyl phthalate	48
Dioctyl phthalate + 5% methyl ethyl ketone	2
Dioctyl phthalate + 5% carbitol acetate	5
Dioctyl phthalate + 5% toluene	7

It is interesting to note that the solvents having greatest swelling power for polyvinyl chloride are the most effective in reducing diffusion time.

3) *Resinous Plasticization* —— A polymeric plasticizer of the polyester type may be emulsified into the resin emulsion. These plasticizers show less tendency to migration than the monomer types, but they must be selected carefully for compatibility with the particular resin system. Thus, certain polyester-type plasticizers are readily compatible with polyvinyl acetate emulsions.

Resinous plasticizer emulsions, such as certain soft acrylic emulsions, may be added to polyvinyl acetate or harder polyacrylic emulsions as plasticizers.

In the case of the polymeric plasticizers, it seems unlikely that diffusion into the harder resin particles could take place, and we must assume that the two resins are so compatible that the soft and hard resin particles merge on drying and immediately form a homogeneous film.

4) *Internal Plasticization* —— The term *internal plasticization* has generally been accepted to mean the co-polymerization of a soft film-forming resin monomer with the monomer of the harder resin. The required softening is obtained, and

TABLE I

SUMMARY OF TYPICAL RESIN-EMULSION POLYMERS USED IN THE TEXTILE INDUSTRY

A1. Polyvinyl Acetates	*% Solids*	*pH*	*Emulsion Type*	*Viscosity cps @ 25°C*	*Particle Size Microns*	*Uses*
1) Large Particle Nonionic	55	4.0-4.5	Nonionic	950-1200	2-10	Piece goods, hosiery-finishing compounds.
2) Fine Particle Nonionic	55	4.0-4.5	Nonionic	1000-1300	1-5	Fine particle type for bright finishes.
3) Fine Particle Anionic	55	4.3-4.6	Anionic	1250-1600	0.5-2.0	Finishes for maximum washfastness.
A2. Vinyl Acetate Copolymer						
4) Alkali-soluble dispersion	35	6-7	Anionic	Less than 100		Bright finish (nylon, etc) Alkali-removable.
5) Ammonia solution of above	20-21	8.5-9.5	Anionic	10,000-15,000	(Solution)	Warp sizing (spot-resistant) for synthetics.
A3. Modified Polyvinyl Acetates						
6) Nonblocking	53-55	5-6	Anionic	1000-2000	0.5-2.0	Piece-goods finish nonblocking.
7) Soft, Nonblocking	55	5.5-6.5	Anionic	1000-2000	0.5-2.0	Piece-goods finish nonblocking-softer finish.
A4. Plasticized Polyvinyl Acetates						
8) Monomerically Plasticized	55	4.0-4.5	Nonionic	1000-2000	2-10	Full flexible finishes for piece goods.
9) Polymerically Plasticized	55	4.0-4.5	Nonionic	1000-2000	2-10	Snag-resistant finish, upholstery backing.
B. Polystyrenes						
10) Anionic, unplasticized	45		Anionic	100-200		
11) Nonionic, unplasticized	40	4-5	Nonionic	300		Delusterant finish.
12) Nonionic, plasticized	50	4-5	Nonionic	500-1500		Durable finish, binder for yarns.
C. Vinyl Chloride Copolymer						
13) Plasticized, film-forming	55	8-9	Anionic	120		Nonwoven fabrics, metallic printing.
14) Internally plasticized	45	3-5	Anionic	10-20		
D.						
15) Vinylidene Chloride Copolymers	45	5-7	Anionic	5-10		Flame-resistant or nonblocking coatings.
E. Butadiene Styrenes						
16) 40:60 Butadiene-Styrene	45	9-10	Anionic	10-20		Backfilling, plushbacking, saturating.
F. Acrylic Ester Copolymers						
17) Hard acrylic copolymer	40	4-6	Anionic	10-25	0.4-0.5	Crisp finish, nonblocking, clear.
18) Medium acrylic copolymer	40	4-6	Anionic	10-25	0.4-0.5	Full finish, nonblocking, clear.
19) Soft acrylic copolymer	40	4-6	Anionic	10-25	0.4-0.5	Soft finish, nonblocking, clear.
G. Acrylonitrile Copolymers						
20) Butadiene-Acrylonitrile	40	8-9	Anionic			Coatings, crock resistance, nonwoven fabric.
H. Styrene Maleic Copolymers						
21) Sodium salt of styrene maleic resin	25	5-7.5	Anionic		(Solution)	Warp-sizing acetates.
I. Polyacrylic Acid						
22) Polyacrylic acid solution	25	1.5-2.0	Anionic	900-1000	(Solution)	Warp-sizing nylon.

the "plasticizer" is actually *part of the resin chain*—hence it cannot migrate or evaporate. (This type of plasticization is sometimes incorrectly used to indicate resinous plasticization. Resinous plasticizers are nonmigrating, but, in absence of cross-linking reactions, cannot enter the polymer chain.)

TEXTILE APPLICATIONS OF RESIN DISPERSIONS

Many factors enter into the suitability of particular resin dispersions in the textile industry. Important properties sought by the textile industry include

Emulsion properties

a) Stability to storage.
b) Stability to mechanical action of padders and application machinery.
c) Low tack in both wet and dry state to prevent sticking to cans and tenter clips.

Film properties

d) Adhesion to fiber.
e) Flexibility and durability.
f) Freedom from discoloration or embrittlement by heat, light, aging.
g) Wash resistance.

The more important aqueous-emulsion polymers and solutions employed in the textile industry are listed in Table I.

A) POLYVINYL ACETATES ——— The polyvinyl acetate dispersions have found the widest acceptance in the textile industry. These dispersions are generally supplied at 55% solids in a complete range of particle sizes (coarse, medium, fine), emulsion systems (nonionic, anionic, or cationic), viscosities, and molecular weights. Some of the more important types are listed in Table I.

Polyvinyl acetates are outstanding in freedom from discoloration and in adhesion to a wide variety of surfaces. Vinyl acetate emulsions are polymerized by a variety of techniques depending on the properties desired in the finished product and on the nature of the emulsifying system. These methods range from batch polymerization to continuous polymerization techniques.

The nonionic dispersions are widely used as fabric stiffening and sizing agents, for back filling and pigment binding, prime undercoats to bind pyroxylin or oleoresinous coatings to cellulosic fabrics, compounding adhesives, and hosiery finishes. These products are the most versatile in stability to mechanical shearing stresses, dilution, and chemical additives (salt, solvents, cationic softeners). However, in the case of nonionic emulsions stabilized with polyvinyl alcohols, the use of borax (often present in starches or casein mixtures) should be avoided. An anionic fine-particle-type emulsion is widely used to produce finishes of maximum washfastness.

Modified polyvinyl acetates are plasticized with monomeric or polymeric plasticizers to obtain a fuller, less crisp hand or are modified with lubricants and release agents to prevent sticking to tenter clips and drying cylinders.

B) POLYSTYRENES———Unmodified polystyrene dispersions do not form films (unless fused at very high temperatures) but dry to a white opaque powder. They are used principally in delustered finishes in conjunction with polyvinyl acetates or thermosetting resins.

Plasticized polystyrene dispersions deposit flexible films, which are sometimes used in fabric finishing in a manner similar to the polyvinyl acetate emulsions for fabric and yarn finishing. The polystyrenes are outstanding in freedom from discoloration by heat or light and in chemical stability.

C) VINYL CHLORIDE COPOLYMERS———Polyvinyl chloride is one of

the most familiar plastics in our daily life. We encounter it in the form of vinyl sheetings and shower curtains, coated fabrics, molded plastic objects, etc.

The monomer, vinyl chloride, is a gas which liquefies at —14°C, and must be emulsified and polymerized under pressure sufficient to keep it in the liquid state.

Since polyvinyl chloride is a relatively hard resin, continuous films are not deposited from aqueous dispersions unless a plasticizer or solvent is incorporated. The technique of plasticization is much more critical than in the case of many other emulsions, and must be studied carefully for any particular system.

Internally plasticized vinyl chloride copolymers are available with comonomers selected to give polymers whose properties allow formation of flexible films from aqueous dispersions at room temperature.

The tendency of polyvinyl chloride to split off HCl on exposure to high temperatures or light is certainly its most disturbing characteristic, since the conjugated unsaturated bonds produce dark-colored compounds. This discoloration is avoided by addition of *stabilizers* (usually metal-organic or epoxy compounds) which retard or prevent this type of decomposition. Adequate stabilization of polyvinyl chloride emulsions is very difficult and merits careful study for any particular system. Advantages of plasticized polyvinyl chlorides for textile work include: toughness of films, water-resistance, and solvent-resistance (particularly toward dry-cleaning solvents).

The vinyl chloride copolymer dispersions are used in textiles as saturants and binders for nonwoven fabrics, as primer coats on fabrics to be coated with vinyl resin (ie, vinyl chloride copolymer) solutions, organosols, or plastisols, or as a sizing for fabrics to be heat-sealed to vinyl film. Nonblocking characteristics make it especially suitable for fabrics to be heated or sterilized. Another use is as a base for formulation of binders in pigment-printing, particularly for bronze-printing compounds. Owing to their slow-burning properties these products may be formulated into low-flammability coatings.

D) VINYLIDENE CHLORIDE COPOLYMERS ——— The vinylidene chloride copolymers produce tough solvent-resistant films which are even slower-burning than the polyvinyl chlorides. Their aqueous dispersions are used principally for finishes where flame-resistance, nonblocking, or very low moisture-vapor transmission are prime requirements and where color retention is less important.

The polyvinylidene chlorides, which have twice as much chlorine as polyvinyl chlorides, are extremely difficult to stabilize to heat and light, and some discoloration on aging is almost unavoidable.

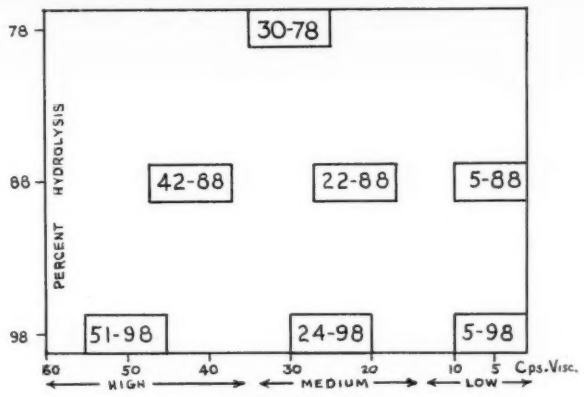

Figure 6
Typical Commercial Range of Polyvinyl Alcohols
(First figure indicates viscosity; second figure, % hydrolysis)

E) BUTADIENE-STYRENE COPOLYMERS ——— The butadiene-styrene copolymers are available in a range of butadiene-styrene ratios, and in a variety of emulsifying systems. Copolymers having more than 70% styrene do not form continuous films, while those having less than 55% styrene tend to be slightly tacky and require curing or vulcanization. Copolymers containing 60% to 70% styrene are used in textiles for backfilling, coating, etc and do not require curing. GRS types containing less styrene are compounded into upholstery backings, rug backings, etc.

F) ACRYLIC ESTER COPOLYMERS ———In the acrylic ester series, film properties can be varied very widely by copolymerization of various acrylic and methacrylic esters, as well as by copolymerization with other monomers. In general, methyl esters yield the hardest polymers, while ethyl, propyl, and butyl are successively softer until maximum softness is reached at 8-alkyl carbons for the acrylates and 12-alkyl carbons for the methacrylates *(6)*. The methacrylates (at least below C_{10}) are harder than the corresponding acrylates.

Uses for acrylic copolymer dispersions became established in textile finishing even before the polyvinyl acetates. The acrylics, like the polyvinyl acetates, yield clear films which do not discolor on aging, are unaffected by heat and light, and show good grease resistance. Their principal disadvantage is higher cost.

G) ACRYLONITRILE COPOLYMERS ———The butadiene-acrylonitrile copolymers form tough, flexible films, which show excellent adhesion to fibers and good resistance to solvents. Aqueous dispersions of this type have been used in textile sizings, backfillings, and plush backings. Recently, polymers of this type have been used in cotton-warp sizings to produce a "loom finish" for denims *(10)*.

H) WATER-SOLUBLE AND ALKALI-SOLUBLE POLYMERS ——— A number of the linear polymers form clear solutions in water or in dilute alkali. These solutions are employed as thickeners and protective colloids as well as sizing agents for yarn and cloth. While these products can no longer be classified as emulsions or dispersions, some of them are derived from emulsion polymers, and the more important types are summarized below:

1) *Styrene-Maleic Copolymers*——— Since maleic anhydride does not polymerize with itself, it is not possible to obtain a polymer containing more than 1 mol of maleic anhydride per mol of styrene. The 1:1 copolymer contains alternating styrene and maleic units. Upon neutralizing the maleic carboxyl groups with alkali, a clear aqueous solution is obtained. Styrene-maleic sodium salt solutions are employed in warp-sizing cellulose-acetate yarns. Sodium or ammonium salts are employed as thickening or sizing agents.

2) *Polyacrylic Acid*———Polyacrylic acid solutions are prepared by polymerization of a water solution of acrylic acid monomer. The large number of carboxyl groups contribute to excellent adhesion to nylon, and dilute solutions are used in warp-sizing nylon yarn, or in throwing nylon yarn for knitting.

3) *Polyvinyl Alcohols* ——— Polyvinyl alcohols are prepared by hydrolysis of polyvinyl acetate. By controlling

the degree of hydrolysis and molecular weight, the properties of the polyvinyl alcohol may be varied to obtain a wide range of products (Fig 6).

The 88%-hydrolyzed grades, particularly types of low and medium viscosity, are employed as warp sizings on cellulose acetates and nylon yarns. The higher-viscosity grades are used as emulsifying and thickening agents.

The 98%-hydrolyzed grades are employed as sizings for cellulose or regenerated-cellulose yarns and fabrics. Since the hydroxyl groups are readily cross-linked by urea-formaldehyde or melamine-formaldehyde resins, small percentages, combined with crush-resistant or shrinkage-control resin treatments, produce a marked improvement in hand and body of fabrics, and result in greatly improved abrasion resistance.

Finishes based on combinations of 98%-hydrolyzed high-viscosity polyvinyl alcohol combined with aldehydes (formaldehyde or glyoxal) cross-link in the presence of a strongly acid catalyst to yield shrinkage-controlled finishes of great durability and improved hand and abrasion resistance, and which show no chlorine retention.

FINISHING TEXTILE PIECE GOODS

A) PURE-RESIN FINISHES ——— Polyvinyl acetate dispersions are most frequently used for general-purpose finishing to impart a stiff or crisp hand to sheetings, dress goods, etc. The nonionic large-particle emulsions are used as general-purpose resins for maximum stiffening effects. Generally, 1 to 5% of the 55%-resin emulsion is applied on a padder as the final operation before drying and calendering or decating. About 2% of sulfated oil or tallow is added to the resin bath for a smoother hand and to impart surface lubricity to prevent sticking to tenter clips and calender rolls. When such finishes are dried on cans, keeping the first cans at not over 170-180°F will help prevent sticking.

For finishing open-weave fabrics, or for dry stiff finishes (marquisettes, nettings, buckrams, ribbons, etc) concentrations of resin emulsions up to 50 to 75% (of 55% emulsion) are frequently employed.

For highest wash resistance, fine particle (often ½ micron or less) anionic polyvinyl acetate emulsions are employed. Wash resistance is improved by baking for a short time at elevated temperature (300°F) to fuse the resin films more completely. Addition of a small amount of formaldehyde or glyoxal to the resin bath is also said to result in increased water resistance and wash fastness.

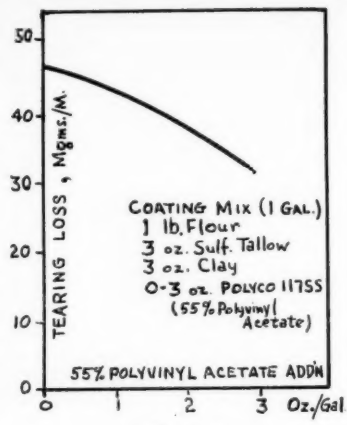

Figure 7

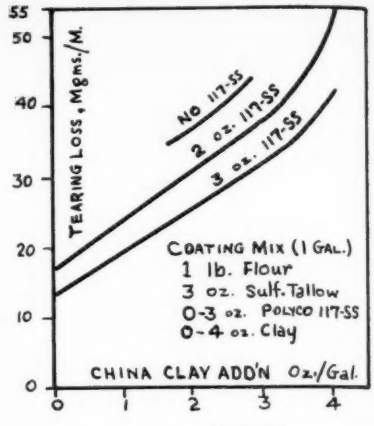

Figure 8

Effect of Polyvinyl Acetate on Pigment Binding Power

An important feature, so far as plant operation is concerned, is that the resin emulsion can be washed off the equipment with a hose. If the resin has been allowed to dry and form insoluble films on the equipment, the films can be stripped off when necessary after softening with a steam-hose. Solvents (alcohol, toluene, ethyl acetate, or acetone) can also be used to soften or dissolve undesired resin deposits.

The polyvinyl acetates show good adhesion on cotton, wool, viscose, acetate, nylon, and synthetic fibers.

Where a fuller hand is required with less stiffening and crispenss, it is necessary to use a *plasticized* resin emulsion. This enables the finisher to use larger amounts of resin to obtain the fullness he desires.

Acrylic-resin copolymers may, in general, be used for the same purposes as polyvinyl acetates. Because of the higher cost of acrylics, however, they are generally used only where their unique properties are desired (eg, greater water resistance, higher blocking temperatures). Another advantage of acrylics is that softer internally plasticized resins can be employed with no possibility of plasticizer migration, and without increasing tack or blocking characteristics.

Plasticized polystyrene and butadiene-styrene dispersions are also used for finishing and back-filling operations in a similar manner. The polystyrenes have outstanding heat resistance and chemical resistance, but lower adhesion to some types of surfaces, owing to absence of hydrophyllic groups on the molecular chain. The butadiene-styrene emulsions have the internally-plasticized feature of the more expensive acrylic types, but are not so resistant to aging and oxidation.

B) STARCH-RESIN FINISHES——— Starch has been used for a long time in textile finishing, and, despite its lack of permanency, it has certain advantages—particularly economic. In cases where wash fastness is required or where synthetic fibers are involved, there is no dilemma, since ordinary starches simply don't do the job.

In many cases, however, the finisher is interested, not so much in durability as in superior binding power, in a particular type of hand not otherwise obtainable, or in a back-filling which shows good adhesion to glue or nitrocellulose. Frequently, the finisher combines starches with resin emulsions to obtain the desired effect more economically. In heavily pigmented back-fillings, replacement of part of the starch by equal money-value quantities of polyvinyl acetate results in a considerable increase in binding power.

In evaluating pigment binding power, a quantitative method has been devised in which the pigment-starch-resin mixture is coated on a standard bleached cotton fabric, dried, calendered, and conditioned. The fabric is then weighed, torn lengthwise, and weighed again. The loss in weight is reproducible for any system and is expressed as tearing loss in milligrams per meter (of linear tear) *(7)*.

Fig 7 indicates the effect of successive additions of 55% polyvinyl acetate emulsion to a 1-pound-per-gallon wheat-flour mix containing 3 oz tallow, and 3 oz clay per gallon *(8)*. The improvement in pigment binding is quite marked, even for small additions of clay and polyvinyl acetate.

Fig 8 shows the manner in which the "tearing loss" increases as the clay-loading increases, as well as the effect of increasing polyvinyl acetate. Thus, by adding 4 oz per gallon of polyvinyl acetate (55%) the amount of clay may be increased 60% without increasing the tearing loss *(8)*.

In combining polyvinyl acetates with starches and dyes, some care must be taken to select a polyvinyl acetate emulsion which has sufficient compatibility. Some emulsion polymers may contain emulsifiers or protective colloids that are sensitive to acids, alkalis, salts, or dyes. It would be incorrect to assume that all resin emulsions act alike in this respect, and the manufacturer may be in a position to suggest emulsion polymers suitable for any particular application.

Many emulsion polymers (particularly nonionic types) contain a small amount of polyvinyl alcohol as a protective colloid. Polyvinyl alcohol solutions are particularly sensitive to the presence of borax in starches, and forms gels with certain dyestuffs. It is also sensitive to the salts which are present in most dyestuffs. Hence emulsion polymers containing polyvinyl alcohol are generally suitable only for mixture with pure, unmodified starches.

C) SHRINKAGE-CONTROL AND CRUSH-RESISTANT FINISHES ——— The linear-polymer resin dispersions, which we have discussed, do not cross-link the cellulose chains in the textile fibers and do not polymerize further within the fibers. Hence, they cannot contribute either shrinkage control or crush resistance, but are used merely for their contribution to hand, stiffness, and abrasion resistance.

When used in conjunction with thermosetting urea and melamine resins, the emulsion polymers produce a marked improvement in hand and abrasion resistance. Polyvinyl acetates are especially suitable for this purpose and form a much more durable finish in the presence of such cross-linking agents. Polystyrene resin dispersions have also been used: the plasticized, film-forming types for improvement of hand and the unplasticized type for durable delustering effects.

The polyvinyl alcohols are also employed in conjunction with either thermosetting resins or aldehydes in the presence of acid catalysts. In either case, the polyvinyl alcohol is cross-linked directly to the resin or cellulose by formation of acetals, and shrinkage-controlled finishes of outstanding washability and abrasion resistance are obtained *(9)*. Polyvinyl alcohols are added also to resin formulations for glazed chintz and durable embossing effects to improve abrasion resistance and to obtain crisp finishes.

D) WOOL-SHRINKAGE CONTROL ———A wool-shrinkage-control system, in limited usage for a number of years, is based on treatment with a specially cross-linked polybutadiene dispersion. The resin is exhausted onto the fiber by gradual addition of acetic acid or salt. A process for treatment of army blankets in laundry machines has been especially effective.

E) COATED FABRICS———Adhesion to a variety of surfaces makes the aqueous resin dispersions especially suitable for prime-coating fabrics to be coated with or adhered to other materials. Thus, polyvinyl acetate is much more suitable than starch for backfilling fabrics for pyroxylin coating. It is common experience that any starch which appears on the face of the goods reduces adhesion of the pyroxylin coating, whereas polyvinyl acetate improves the adhesion of the pyroxylin. If the coated fabric is to be glued to another surface, the polyvinyl acetate backfilling will also adhere better to the glue.

For fabrics to be coated with vinyl chloride-acetate resins, finishes based on the plasticized vinyl chloride-copolymer emulsions are more suitable as sizing agents.

Fabrics to be treated with oleoresinous coatings are pretreated with finishes based on polyvinyl acetate or butadiene-styrene latices to obtain a smoother surface and better adhesion.

The emulsion polymers are also used as clear coatings over decorative fabrics to improve the crock-resistance of dyes and pigments and to improve weather resistance. Acrylic copolymers, vinyl chloride copolymers, and acrylonitrile copolymers are especially suitable for this purpose.

F) RUG AND UPHOLSTERY BACKINGS———Rug backing in the earlier days consisted in applying a starch sizing on back of the finished rug to *hold the tufts in place* and to *impart stiffness* and handle. Starch finishes were low in cost, but nondurable and tended to wash out when the rug was shampooed or to "dust out" on mechanical handling.

The introduction of emulsion polymers has resulted in a revolution in the rug industry, and rugs and carpets can now be shampooed "on site" without removal from the floor. The backings are more durable in all respects, and tuft-binding properties are greatly increased.

Requisites for a good rug-backing compound include the following features:

1) Good aging properties
2) High tensile and tear strength
3) Freedom from odor
4) Water-resistance of films
5) Good adhesion and binding properties
6) Mechanical stability of emulsion
7) Adhesion of backing to seam-sealing compounds

The rug backing is generally applied by roller coating as a final operation. While the ideal compound has all the above properties, in actual practice, some compromise is necessary. Thus, maximum stiffening is desirable, but contraction on drying might result in puckering of the rug, and the resin formulation must be adjusted for optimum film properties and freedom from puckering.

Compounds based on butadiene-styrene copolymers have been highly successful in this field, and are generally applied, dried, and *cured* or *vulcanized* to obtain the desirable properties imparted by cross-linkage.

More recently, certain vinyl-resin dispersions have been found quite interesting for this application. The vinyl resins do not require curing, but are generally "fluxed" at high temperature for a short time to improve film properties.

Upholstery backings are applied to bind the tufts of pile fabrics or to prevent synthetic-yarn slippage. Synthetic butadiene-styrene copolymers have dominated this field also. One difference in requirements is due to the fact that upholstery backings are generally applied to the grey goods, and must withstand the subsequent scouring and dyeing treatments without disintegrating. The vulcanized synthetic rubbers have been most successful.

Where the upholstery fabric is woven from colored yarns, it is possible to use certain vinyl emulsions, which do not require curing or vulcanization.

An interesting further requirement for automotive fabrics is that both the fabric and the backing must withstand spotting with dry-cleaning solvents and must not show a discolored ring. Where the fabric covers asphalt board, the backing must also act as a barrier to prevent bleed-through of asphalt when dry-cleaning solvents are applied. Special polyvinyl acetate dispersions have produced interesting results for this application.

G) HOSIERY FINISHES———Finishes for improvement of the hand and snag resistance of nylon hosiery are almost universally based on polyvinyl acetate emulsion polymers, modified, where required, with polymethacrylate or polystyrene dispersions for delustering.

The formulation of hosiery-finishing compounds has become a highly specialized art in which the resin emulsions, stiffening agents, softeners, and exhausting agents are combined in one or two components by the hosiery-finish manufacturer for use by the hosiery dyer.

For this purpose, the nonionic, large-particle, polyvinyl acetate emulsions are generally employed because of their excellent compatibility with other ingredients, such as cationic and anionic softeners and surface-active agents. They are readily diluted with water, and the pH of the emulsions can be adjusted with dilute acetic acid or dilute alkalis or ethanolamines.

Application of hosiery finishes is generally accomplished by diluting 5 to 15% of the emulsion (on weight of fiber) with 5 to 6 times its weight of cold water, added while the machine is running. The bath ratio is generally 20 to 30, and the batch is run at 90 to 110° F for 10 to 15 minutes to complete exhaustion of the finish. Delustering may be accomplished by adding a few percent of unplasticized polystyrene emulsion or polymethyl methacrylate emulsion, or mineral delusterant after the batch has run about 5 minutes. This is usually followed by addition of a small amount (½ to 5%) of cationic or wax-emulsion softener, which also acts as a boarding lubricant. Some softeners also improve exhaustion of the finish. The finished hosiery are hydroextracted and boarded in the usual manner.

Actually, experience indicates that larger amounts of resin are required for real snag resistance than is generally applied for the proper finish and hand. However. increasing the amount of resin too much results in boarding problems, and the finisher must reach a compromise between snag resistance and working properties.

Recently, combination snag-resistant and detergent compounds have been placed on the consumer market, so that women can wash and treat their hosiery for snag resistance in one operation. These compounds are based on polyvinyl acetates and polyacrylic compositions.

H) NONWOVEN FABRICS——Nonwoven fabrics are manufactured from either parallel fiber card webs or from random webs by binding the fibers into a sheet by use of emulsion polymers.

The webs may be surface-coated with resin emulsion by means of a roller coater, or parallel stripes may be printed across the web in an analogy to woven filling-yarn construction.

The type of emulsion polymer selected depends on the intended usage. Polyvinyl acetates, polyvinyl alcohols, vinyl chloride copolymers, vinylidene chloride copolymers, and acrylonitrile copolymers are all used to obtain different effects.

Nonwoven fabrics are finding ever-increasing uses for disposable towels, diapers, washcloths, and sanitary items. New industrial uses make it fairly certain that the nonwoven fabric industry will continue to expand for some time.

YARN PREPARATION

A) THROWING OF KNITTING YARNS —— Nylon and other synthetic yarns for hosiery or tricot knitting are generally single-end-sized with the PM90-type size, which is based on low- or medium-viscosity polyvinyl alcohol (5 cps, 88%; or 22 cps, 88% hydrolysis) solutions containing boric acid. Depending on yarn twist and denier, solutions containing 2 to 5% solids are employed for hosiery yarns, 1% to 1.5% for tricot.

Low-viscosity polyacrylic acid has been quite successful as a single-end sizing for tricot knitting yarns (at 0.5% to 1.5% solids).

Because of its high acidity, however, yarns so sized cannot be used for wet knitting unless all equipment (including knitting needles) are of stainless steel.

B) WARP SIZING——Starch has long been the basis for cotton and spun-rayon warp sizings, but does not adhere well to synthetic yarns. For nylon warps, the partially hydrolyzed polyvinyl alcohols and polyacrylic acids are used quite successfully. Gelatin was used at first on cellulose acetate yarns, but was largely displaced by polyvinyl alcohols and styrene-maleic-copolymers.

Spot-resistant warp sizings have recently become quite important for *loom-finished fabrics*. With the increasing use of dope-dyed yarns, loom-finish fabrics have become much more important and more economical, since the fabric may be sold just as it comes from the loom, and need not go through the complicated finishing-plant operations.

One serious drawback which has hindered the development of loom-finished fabrics has been the fact that the gelatin, polyvinyl alcohol, and styrene-maleic warp sizings are water-soluble, and water drops which accidentally fall on the fabric or garment during steam-ironing, sewing, or during a shower, dry out and leave rings.

The first spot-resistant finishes were based on thermosetting-resin combinations. Since the application of these thermosetting resins was somewhat troublesome, and finishers are wary of thermosetting resins that are cured but not washed, the development of a new class of loom-finish sizings was welcomed by the industry.

The newer loom-finish sizings are based upon ammonia salts of special vinyl acetate copolymers or on specially modified styrene-maleic compounds. Upon drying, these particular ammonia-resin salts break down, liberating ammonia, and forming a water-resistant film. When a drop of water is allowed to fall on a fabric sized with these compounds, there is less spreading and the resulting spot dries without any visible residual mark.

SUMMARY

Emulsion polymers are available in a wide range of polymer and copolymer compositions, possessing the varied physical and chemical properties described. The great number of uses for these polymers in the textile industry will continue to increase.

No one polymer will displace all the others, since each type has its own advantages, but the use of many types will increase in proportion to the unique individual applications found for them.

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Membership Applications

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Philadelphia Section——

DYEING WOOL BLENDS AND OTHER FIBERS FOR CARPETS*

HARRY F CLAPHAM

E I du Pont de Nemours & Co, Inc, Wilmington, Del

THE array of fibers currently being used for carpet manufacture presents a marked change over the past 15 or 20 years from the standard carpet with a wool face and a cotton and jute backing. We still have the wool carpet, but, in addition, there are carpets composed of blends of wool with other fibers and other fibers alone. In the brief time allotted to me, it will only be possible to "high-spot" the present techniques and perhaps to mention one or two new developments in the dyeing field that are showing promise.

Since the dyeing of wool for carpets is still the most important on a volume basis, let us first review the methods and colors used on this fiber.

OLDER CARPET-DYEING METHODS

YARN——The first technical demonstration I made was on the dyeing of carpet yarn in a Hussong machine. At that time, 15 years ago, approximately 80% of all the wool for carpets was yarn-dyed, most of the rest being stock-dyed, while only a very small amount of piece dyeing was being done. Largely because of the increased popularity of wall-to-wall carpeting in solid shades, with the resulting requirement for large quantities of yarn of exactly the same shade, the ratio of stock dyeing to piece dyeing has practically reversed, and in the past few years as much as 80% of the wool carpets has probably been stock-dyed. In the last year or two there has been some deviation from this trend, and recently there appears to be an increase in yarn dyeing.

STOCK DYEING——Stock dyeing, which comprises a very large percentage of the current production, is usually carried out in a Smith-Drum, Venango, or Riggs and Lombard type of machine, or in a Hussong raw-stock machine, the former type being the more important. Dyestuff selection for carpet raw-stock dyeing is quite different from that for garment-wool raw stock. Unlike garment fabrics, carpets have no requirements for fastness to the processes of fulling, scouring, carbonizing, decating, etc. In fact, practically the only processing fastness requirement for carpets is that of steaming, which is used for twist setting, especially on high-twist yarns. Because of this unusual situation, coupled with the change from yarn to stock dyeing, the line of least resistance has been to convert formulas from yarn to raw stock practically without change. While this method of formulation eases the problems of shade matching, especially with regard to artificial light and level dyeing, it does not take advantage of the possibilities of improvements in the fastness of dyeings to consumer tests. Some manufacturers are replanning and changing their raw-stock formulas to take advantage of the best available dyes, but, by and large, level-dyeing acid colors with their relatively poor fastness to all types of wet tests are still selected for carpet-wool raw stock.

It is the speaker's strong recommendation that serious consideration be given to the neutral-dyeing fast-to-light color types now available for shade formulation on carpet raw stock so as to gain the ultimate in fastness to both light and wet tests.

H F Clapham

The methods of dyeing carpets have needs changed as carpets have changed from an all-wool face or pile to carpets with a face composed of a wool blend or of all cotton, all rayon, or all nylon fibers. But the author discusses not only the changes in the dyeing of carpets resulting from the introduction of fibers other than wool into carpet manufacture, he also points out that new methods of dyeing are now applicable to wool itself, namely, continuous stock dyeing, high-temperature dyeing, and neutral dyeing with new types of metallized dyestuffs with superior fastness properties.

PRESENT DYEING METHODS

YARN —— Yarn dyeing is usually carried out in a Hussong-type machine with a small amount being done in package and Klauder-Weldon-type machines. The Hussong machine is preferred over the package machine in most cases, because it gives a loftier yarn with better burst properties. The package machine is being used with success on single yarns that are later plied. The Klauder Weldon machine generally has a much lower rate of production and has only very limited use. Level-dyeing acid types are used almost exclusively for yarn dyeing, although there are a few cases where the neutral-dyeing fast-to-light, chrome and premetalized types are being used where especially good fastness is required. Color matching in yarn dyeing is a much more exacting art than for raw stock since each lot of yarn must be carefully matched to the standard. Raw-stock dyeing overcomes this difficulty by laying down larger blends, frequently as large as 80,000 lb. With such blends it is possible to dye 70 to 80% of the required stock close to shade, to make a sample yarn and then to dye a few batches to bring the shade exactly on tone without having to resort to color feed on any of the dye batches.

PIECE DYEING —— Piece dyeing for wool carpets has been practiced in a small way for several years, usually on the somewhat lower-grade carpets. It is done in an open-width reel machine, usually with union-dyeing types. Care must be taken not to use acids in application that may damage the cellulosic backing material. Undoubtedly there are numerous experiments under way on tufting machines for the production of wool-tufted carpets, which may greatly increase the interest in piece-dyeing wool-faced carpets.

HIGH-TEMPERATURE DYEING ——One of the new developments currently under investigation involves the use of temperatures above 212°F for the application of level-dyeing, neutral-dyeing, and chrome colors to wool yarn in package machines or in skein or raw stock form in a raw-stock machine. Extensive experiments, including pilot-plant quantities as large as 100 lb of hard-twist carpet yarn, have indicated that it is possible

* Presented at the Penn-Sheraton Hotel in Philadelphia, on Friday, Sept 11, 1953.

to produce level, well-penetrated dyeings on skeins of hard-twist carpet wool in a raw-stock circulating machine with a dyeing cycle of approximately 40 minutes at 225°F in the pH range of 4.5 to 5.0, which is close to the isoelectric point of wool. Similar yarn that was dyed at an atmospheric boil required 3 to 5 hours with level-dyeing acid types to obtain satisfactory penetration and levelness. Physical tests on the yarn dyed at high temperature indicate that its physical condition is at least as good as that of the yarn dyed at the atmospheric boil. A paper presented by R J Thomas before the Northern New England Section *(1)* on the high-temperature dyeing of wool covers this work in much more detail.

CONTINUOUS STOCK DYEING———A second new development, which is also in the pilot-plant stage, involves the dyeing of wool raw stock in one bowl of a scouring train at a rate of approximately 25 lb per minute. Successful full-scale trials on quantities up to 7,000 lb have been conducted in several plants, and the indications are that, with properly designed equipment, it will be possible to effect substantial savings in labor and steam and to produce dyeings at least equal in quality to those currently produced by the batch process. The method is based on the premise that good exhaustion and fixation of selected colors can be obtained in very short times under suitable conditions of temperature and pH. Capracyl colors and other neutral-dyeing fast-to-light types have shown much promise in this work. Shade control appears to be remarkably simple, and levelness and fastness compare very favorably with more conventional dyeing procedures.

WOOL BLENDS FOR CARPETS

UNION DYEING———Since the Second World War the price and availability of good carpet wools have necessitated the use of blends of wool with other fibers in order to produce economical carpeting in good supply. Rayon and acetate are both being used in varying percentages in blends with wool to produce good carpets at a moderate cost. The rayon-wool blends have been dyed in both raw-stock form and yarn form. Yarn dyeing presents the more difficult problem since both neutral-dyeing wool colors and selected direct colors for the rayon must be combined to obtain the desired shades. At least six colors are usually required in such dyeing, and since exhaustion in a union bath is never complete, reproduction of the shade from lot to lot demands much more careful attention than straight wool dyeing.

ACETATE AND WOOL———Where acetate has been blended with wool, the normal procedure is to stock-dye the acetate raw stock and the wool separately and to blend them in the dyed state. Since acetate colors are required for the acetate fiber, care must be taken to insure that the fastness properties, especially fastness to gas fumes, are satisfactory for the end use. There is currently some experimental activity in the use of dope-dyed acetate carpet stock, which greatly simplifies the problem of dyeing blends.

NYLON AND WOOL———In addition to the use of these two fibers for carpets, there are indications that a percentage of nylon, probably in the order of 20%, can be incorporated in carpets to improve abrasion resistance. Yarns of this type can be union-dyed with selected acid colors, as is currently done in the garment-fabric trade. Or, alternatively, the stocks can be dyed separately and blended, with the resultant easing of the problems of obtaining a good union between the two fibers.

COTTON CARPETS———In addition to the all-wool and part-wool carpets, there has been a marked increase in the past few years in the use of cotton carpets. This material originally started as tufted chenilles in the bath-mat and related fields, but in the last few years has developed even to wall-to-wall carpeting. It now represents a sizeable yardage of material each year. The speedy production brought about by the the use of special sewing machines to replace looms makes the manufacture of cotton carpeting relatively inexpensive. A typical sewing machine for the manufacture of this carpet may be as wide as 18 feet and may produce 6 feet of tufted carpet per minute. A large proportion of the cotton carpeting produced today is dyed in the piece, either in rope form or in open width, depending largely on the weight of the carpet.

DYES FOR COTTON CARPETS———Cotton carpeting is usually dyed with fast-to-light direct colors. Level-dyeing properties, fastness to light and suitability for rubberizing are the properties that must be considered in color selection. There has been a small quantity of this type of carpeting dyed with vat colors, but the relatively higher cost of this type of dye has greatly hindered its wider adoption.

There is also some tufted cotton carpeting made up from stock-dyed cotton. In this case vats or fast-to-light directs are employed.

RAYON CARPETS———Some quantities of 100%-rayon rugs have also been produced, the majority of which have been dyed with fast-to-light direct colors, although, in the case of the smaller sizes, some work was done on vat-dyeing individual rugs in laundry wheels with very good results.

NYLON CARPETS———The final carpeting fiber I should like to mention is the 100%-nylon carpeting, which is produced in small quantities at extremely high prices ($50 per sq yd). Most of this carpeting is dyed in yarn form, usually skeins in a Klauder-Weldon type of machine, with disperse (acetate) dyes. The fastness of this color type has proved adequate for the end use, even though these rugs have very long wear life. Since they are frequently stripped and redyed on a custom basis to match changed decoration schemes in the home in which they are installed, the use of acetate colors is desirable to facilitate subsequent stripping and redyeing. Redyeing is usually done in piece form in an open-width reel machine. Dyeing on location on the floor is known to have given disastrous results on occasion.

CONCLUSION

In this brief presentation, I have attempted to review for you the current methods of dyeing the different fibers used in carpets. I would like to stress again the fact that substantial improvements in obtaining better fastness to consumer tests are possible in many of the current practices in dyeing wool raw stock for carpets. The use of fast-to-light neutral-dyeing wool types would yield marked advantages over the currently and widely used level-dyeing acid types, with no significant differences of dyeing properties that cannot be handled by modification of dye methods and very little increase in cost. The use of such neutral-dyeing types in a pH range near the isoelectric point of wool would result in less damage to the wool fiber and, consequently, better wearing qualities.

The use of elevated temperatures in yarn dyeing and the continuous dyeing of carpet raw stock have been mentioned only briefly. It is expected that you will hear more of these two processes in the future as their advantages become recognized and adopted by the industry.

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Philadelphia Section——

CARPET SOILING*

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INTRODUCTION

With the incoming of synthetic fibers in the conventional carpet field, the problem of soiling became pronounced because of certain factors involving both the fiber structure and the carpet contaminants. The study of carpet soiling has been in progress continually for the past three years, and the results of our findings are the substance of this paper. But first a brief review of carpet manufacturing may assist in the understanding of the sequence of operations through which fibers must pass in being converted from staple to yarn to carpet.

The conventional constructions, which include Axminster, Wilton and velvet, chenille and plush, and the tufted or punched types, account for the bulk of the carpet production today. The conventional carpet traditionally has used all-wool face yarns, and only since 1946 have rayon and other man-made fibers made appreciable inroads into this field. Today, conventional carpet yarns are either all-wool, all-rayon or synthetic, or blends of wool and man-made fibers, such as rayon and acetate. In the quality-carpet line, blends of acetate or rayon with wool are next in performance to all-wool, because the soilability and crushing are minimized by blending these synthetic fibers with wool. In the case of the conventional carpets, the bulk of the pile yarns are spun on the woolen system. In Axminster, Wilton or velvet carpets, the pile yarns are imbedded during weaving. The back in the woven constructions may consist of cotton or continuous-filament rayon with jute or paper stuffer yarns as is the case with Wiltons and velvets; and jute or paper or cotton filling yarns as is the case with Axminsters. Other variations in the backing material include starches or sizes applied to the backing yarn either before or after weaving. The back-sizing operation is common to Axminster carpets. Carpet finishing for the conventional type includes burling, steaming, shearing and back sizing.

The tufted-type carpet within the past few years has developed in such a way as to partake in the quality-carpet market in full broadloom widths. At the present time the bulk of the tufted-carpet production is made in cotton yarns, and it is only within the past two years that rayon has made appreciable headway in this field. The yarns from rayon staple for the tufted trade are produced on woolen, cotton and jute systems and are mostly in the sales-yarn category. In this construction the insertion of the yarn as pile into a heavy cotton fabric is accomplished by means of needles through which the yarn is threaded. These needles pierce the cotton fabric and work in conjunction with needle hooks, which form the required pile loop or tuft. The bulk of these yarns are prepared undyed, since dyeing is carried out as a piece-dyeing operation in most cases. The only finishing operation other than dyeing for tufted carpets is the application and curing of a back coating of latex emulsion. This treatment serves to add stiffness to the back of the fabric.

Since there are many variations in the manufacture of carpets of different types, which in turn will influence the soiling characteristics, attention must be paid to these variations and the part they play in the performance of the end product. Quite naturally, our interest has been concentrated on evaluating the Axminster, velvet and tufted types. Although most of the studies that were undertaken to investigate the problem of carpet soiling were made on Axminsters, the result can be related to other constructions because factors which influence the soiling of one type come into play in varying degrees for the other carpet types.

K L Whitney

Several important soiling criteria which are peculiar to carpet soiling are discussed. Oily contamination of carpet fibers, whether through producer finishes, processing additives, machinery lubricants or backing-yarn oil lubricants, promote carpet soiling. The control of these contaminants is suggested and demonstrated.

THEORY OF CARPET-FIBER SOILING

If one considers the soiling of textile fabrics in general and attempts to determine the causes of soiling, it will be realized that certain mechanisms are involved which are defined to a large extent by the end use of the fabric. It can readily be seen that the soiling of floor coverings is entirely different from the soiling of curtains or garment fabrics, nevertheless, certain soiling mechanisms can overlap and apply to each of these consumer goods.

Leonard & Schwartz *(1)* have discussed the mechanisms of soiling and have differentiated between impingement and retention mechanisms. Impingement is the mechanism through which the soil is brought into contact with the fiber. The mechanism for impingement includes direct transfer of bodily carried soils and the interception and deposition of airborne soil. The retention mechanism includes oil bonding and occlusion in pits and crevices on the fiber surface.

Carpet soiling is a direct result of these mechanisms: impingement by direct transfer and deposition; retention by occlusion and oil bonding. Possibly there are other mechanisms which come into play in carpet soiling, but it is doubtful that they share equal importance to those already mentioned. Electrostatic forces *(2)* have been mentioned as contributing to soiling, and it is conceivable that they might play some part in the soiling of fibers, particularly the hydrophobic fibers.

In attacking the problem of increasing the soil resistance of a carpet fiber, it is obvious that nothing can be done to alter the soil-impingement mechanism. On the other hand, certain factors can be controlled which can greatly reduce the retention mechanism. These factors will involve both the structure of the carpet fiber and the construction of the floor covering.

The mechanical forces involved in car-

* Presented by K L Whitney at the Penn Sheraton Hotel in Philadelphia on September 11, 1953.

pet soiling serve to press the soil into the surface of the fiber, either into naturally occurring crevices and cracks or serrations, or into spongy areas of the fiber. It would appear that a fiber could be engineered with a surface free of serrations, cracks or other irregularities, which would resist retention by soil occlusion. Naturally, retention of soil by oil bonding can be overcome to a large extent by keeping fiber finishes and oil contamination down to a minimum. Unfortunately, a carpet during its life will be subject to oil contamination because of local atmospheric conditions, or to residues left in the carpet as a result of shampooing or cleaning *(3)*.

In the investigation of the soil retention of various fibers, Masland *(4)* reported the following findings:

1) Fiber diameter and cross-sectional outline to be of paramount importance.
2) These factors are interdependent, and, when a fiber has a diameter of 27 (microns) and a smooth circular cross section, a low soil retention is obtained.
3) The origin of the fiber, either natural or synthetic, animal or vegetable, is of no importance, except as origin influences the morphology.

Using a more indirect method of soil-retention measurement, Compton & Hart *(5)* concluded that adhesion of soil under conditions of their experiments is a function of pitting, roughness of the fiber surface, and particle size of the soil. Sorption was concluded to be an unimportant factor. The differentiation between macro and micro soiling on the basis of particle size was made with micro soiling being the most pertinent.

The findings of Compton & Hart will help in understanding Masland's findings concerning diameter and cross-sectional shape of the fiber. It is known that certain fibers that have a round cross section are not soil-resistant when compared with serrated fibers. The same fibers will appear to be soil repellent when tested with soils of large particle size, but they will readily soil with soils of small particle size. It has been shown that street soils *(6)* have a particle size as small as 1/10 of a micron. Therefore, an examination of the fiber surface at magnifications of 500 diameters may indicate smoothness, but irregularities and pits affording soil-holding sites are evident at much higher magnifications. The soil-resistant fiber, therefore, will have smoothness of surface in macro and micro dimensions for any shape, the micro dimension being defined as sub-micron. The available surface area is also a factor which associates itself with soil resistance. Thus, low-denier fibers will soil to a greater extent than higher-denier fibers since a greater surface area per unit weight of the low-denier fibers is available. Soil resistance is a function of denier size, but advantage may be taken of this property only to a limited degree since the other properties, such as hand, cardability and cover, are influenced by denier size.

As stated before, the oil-bonding properties of the fiber result, in a large part, from contamination of the fiber. Examples are the natural or producer finishes purposely applied to the fiber. For example, wool is scoured to approximately 1% grease content, which serves as a natural lubricant in processing, and man-made fibers such as viscose or acetate contain producers finishes. The type and concentration of the finish present on the fiber can influence in no small way the soiling properties of the fiber. Other contaminants are those which are picked up by contact of the fiber with textile machinery in the yarn-preparatory processes, and also through the application of fiber lubricants, such as carding and spinning oils. Examples of these are card-rub apron dressings, spinning-ring lubricants, bearing lubricants and wool oils. Other contaminants which may effect the fiber-soiling properties may originate in the backing yarns, either jute, paper or cotton.

If carpet staple is dyed in raw stock, as is the general case, the producer finishes and other contaminants may be greatly reduced, but contamination from textile machinery lubricants and processing lubricant oils are carried by the fiber into the finished carpet. Skein-dyed or package-dyed yarns may have most of these contaminants eliminated. On the other hand, dyeing assistants incompletely rinsed from the material after dyeing may actually serve as soil-bonding agents.

EXPERIMENTAL

FIBER-SOILING COMPARISONS ———In Figures 1, 2, 3 and 4 are shown cross-sectional and longitudinal views of 15.0-denier crimped carpet rayon and Tufton carpet staple. These sections were made on soiled tufts extracted from service-tested carpets. They clearly illustrate what takes place when these two fibers are soiled under exactly the same conditions. Because of the fact that crimped carpet rayon has a highly serrated and pitted surface, the soil is retained in the serrated areas. This retention demonstrates the occlusion theory. The crimped carpet rayon is also very sensitive to lubricating-oil contamination from the textile-processing equipment. When the factors of soiling through oil bonding and soil occlusion are superimposed upon one another, the removal of the soil through normal household cleaning methods is almost impossible.

A new rayon carpet fiber has been developed by the American Viscose Corporation and has been thoroughly inves-

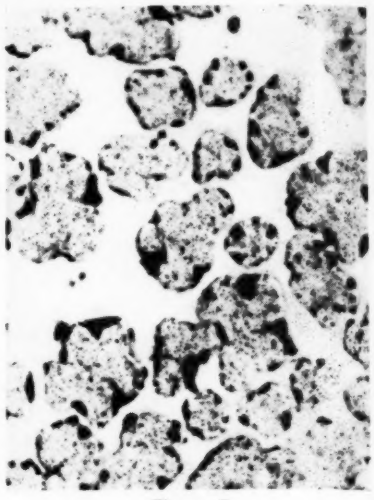

Figure 1

Figure 2

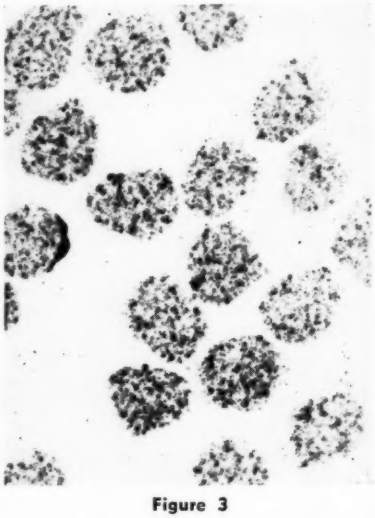

Figure 3

NOTE: The small dark specks in Figures 1 and 3 are not soil but the white pigment used to deluster the fiber.

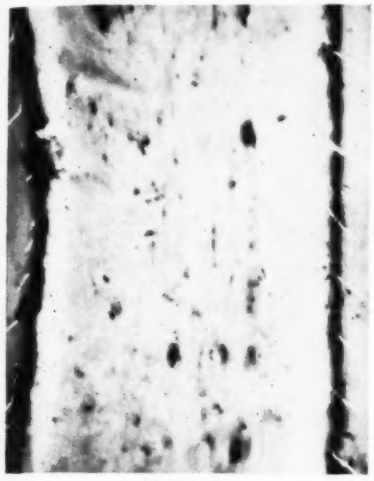

Figure 4

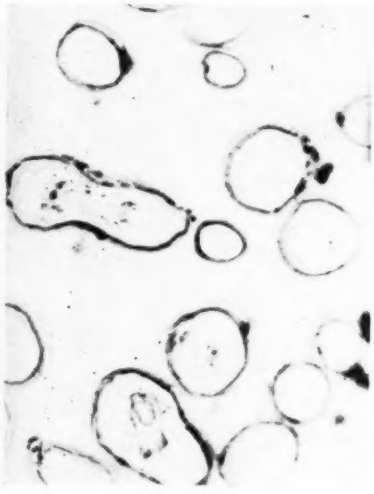

Figure 5

Figure 6

NOTE: The reader must be cautioned against making direct comparisons between the samples and fibers in Figures 7 and 8 (see page P146) because of monochromatic results of black-and-white film.

tigated as to its performance soilwise in carpets. We refer to this fiber as Tufton. This fiber is manufactured with a completely smooth surface to eliminate many of the aforementioned causes for the soiling of carpet fibers. Its performance in carpets soilwise equals wool in most respects in that

1) It is not sensitive to the presence of oily-jute backing yarns as it will not allow jute-oil migration into the pile yarns.

2) It is relatively insensitive to oil contamination from textile-processing equipment.

3) It will release nearly 100% of its soil upon scouring.

4) It will, with added delustrant, give the appearance of soiling less than wool.

In Figures 5 and 6, the longitudinal and cross-sectional views of soiled carpet wool show how wool scales hide the soil. Wool apparently is soil-resistant to a high degree because of its smooth, hard, surface scale. Evidently either the physical or chemical makeup of the wool fiber inhibits jute-oil migration when in contact with regular jute backing yarns.

The Firth Carpet Company prepared a series of yarns that were to result in a very conclusive soiling test in Axminster carpets. The comparison between wool, synthetic fibers, and 50/50 blends of each synthetic fiber with wool was made with both dyed and undyed (natural) pile yarns.

The type of jute backing and the processing specifications were altered for a complete picture as to the performance soilwise of each pile yarn under these different conditions.

In Figures 7 and 8 the nomenclature refers to the following:

YARN FINISH

Oil: Pile yarn was processed with the addition of a processing oil before carding and was then mule-spun.

Dry: Pile yarn was processed without the addition of processing oil and was then mule-spun.

Softener: Pile yarn was processed with the addition of a cationic softener before carding and was then mule-spun.

JUTE BACKING

Oily: Refers to regular jute filling yarns containing between 8 to 12% oil.

Stainless: Refers to jute filling yarns containing less than 1% oil.

PILE YARN

Tufton: 100% 15.0-Denier, 3" staple, with normal and twice-normal delustrants.

Wool: 100%-Wool control.

Regular Rayon: 100% 15.0-Denier, 3" crimped Avisco "15".

Acetate: 100%, 17.0-Denier, 3" dull acetate.

50% Wool, 50% Cellulosic: 50/50 Blends of wool control and cellulosic.

These samples clearly illustrated the precautions that must be taken to insure consumer acceptance soilwise of carpets. Here are several conclusions with respect to soiling one may draw from examining the soiled samples:

1) Both crimped carpet rayon and acetate are very sensitive to jute-oil migration from regular (oily) jute backing yarns.

2) Both wool and Tufton carpet staple are not affected by the presence of oily-jute backing yarns. These fibers are less sensitive than the other cellulosics to additive processing oils and finishes.

3) The soilability of all fibers is reduced to the greatest degree through the use of stainless- or low-oil-content-jute backing yarns.

4) Dry-spun yarns are more receptive to jute-oil wicking than those spun with the addition of certain-type softeners. This is especially true in the case of crimped carpet rayon and acetate, but these softeners are of little advantage when low-oil-jute or paper yarns are used.

Since the dry cleaning of carpets is not commercially practiced in carpet production mills today, the prevention of the accumulation of oil-bonding materials on the carpet fiber may be controlled by good housekeeping and good mill practice.

Oily or regular jute (8 to 12% oil and grease extractables) is marked as a major factor in carpet soiling. The obvious explanation for the greater soiling of carpets made with regular jute is that the jute oil migrates or wicks to the pile or face yarn and increases the affinity of the pile fiber for soil. The soiling due to jute oil may be eliminated or reduced by the addition of less oil in the manufacture of the jute yarn or by the substitution of some other nonmigrating finish. Jute-oil contamination is readily controlled through the use of stainless jute (low-oil content) or paper yarns, which are entirely satisfactory for carpet production.

The evidence and theory presented herein clearly points out that the carpet manufacturer must investigate his processing and take every necessary precaution in order to prevent oil contamination of the pile yarns. When the carpet-pile-yarn contamination is minimized and under constant control, the manufacturer can be assured that his product will receive a higher degree of consumer acceptance.

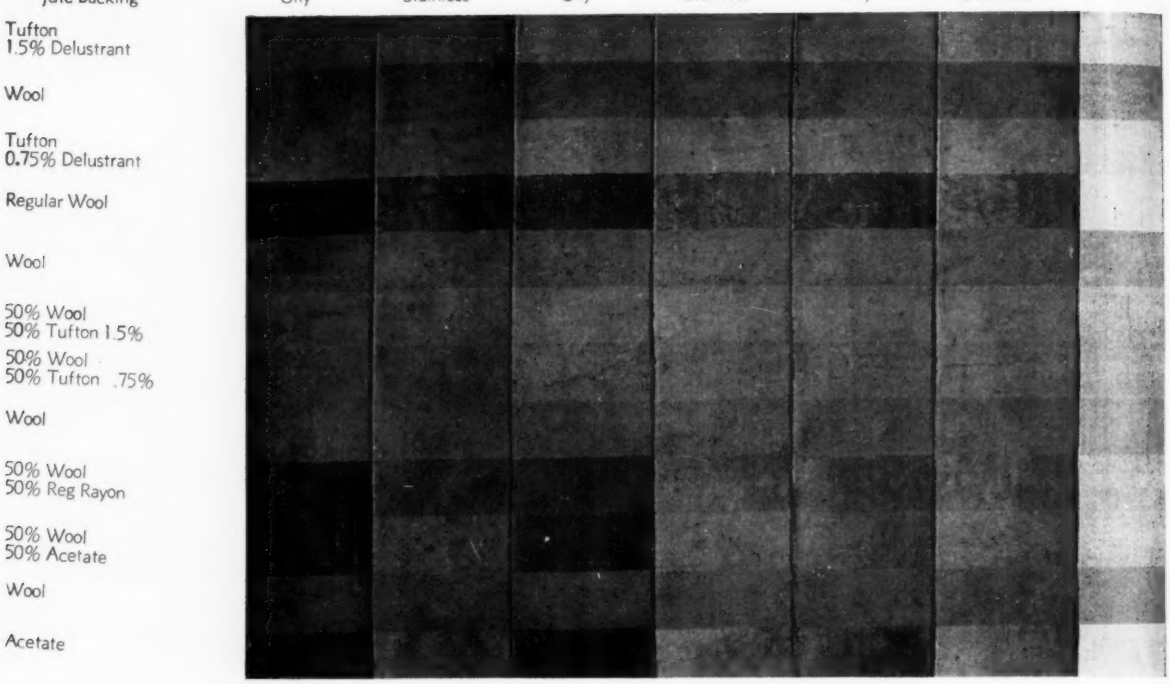

Figure 7

Comparison of the Effect of Different Conditions of Manufacture and Fiber Composition on the Service Soiling of Undyed Axminster Carpet Samples

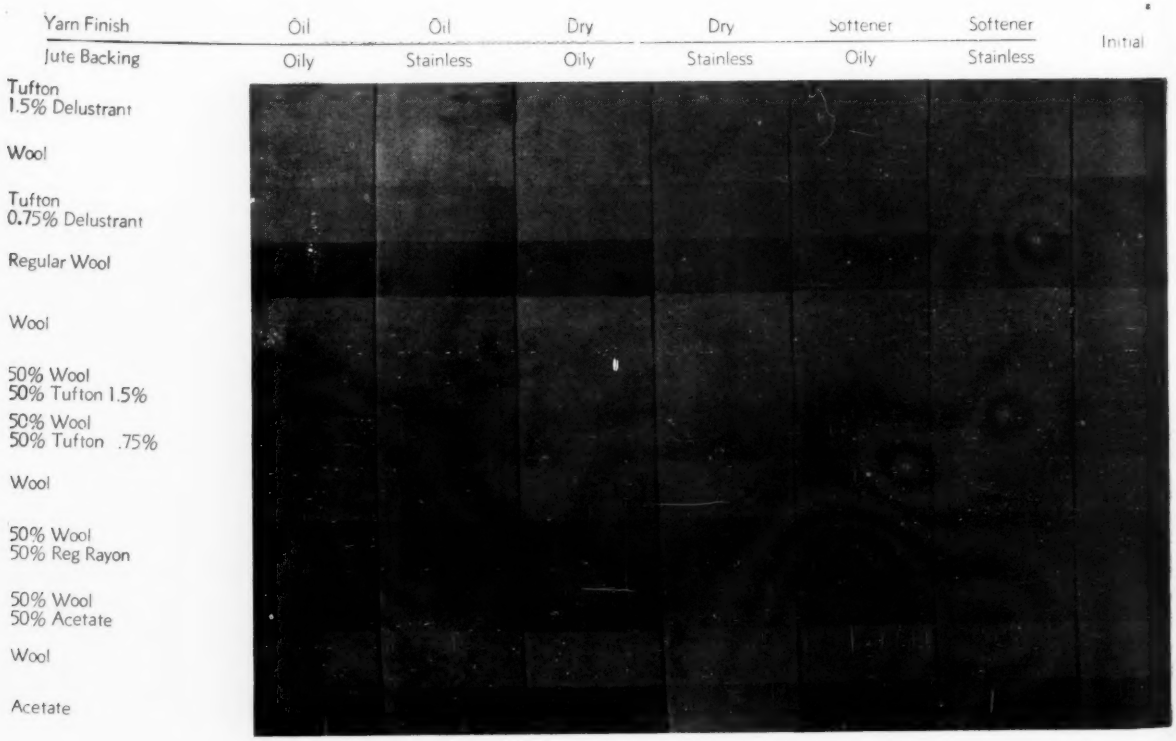

Figure 8

Comparison of the Effect of Different Conditions of Manufacture and Fiber Composition on the Service Soiling of Dyed Axminster Carpet Samples

We have attempted to demonstrate that carpet rayon can be engineered and processed so that its performance in carpets will compare favorably with wool in respect to soiling. Science does not permit a satisfied attitude, and the rayon industry will continue its efforts to produce a carpet fiber possessing the necessary characteristics for ultimate consumer acceptance in 100% form.

ACKNOWLEDGMENTS

A large portion of the findings disclosed in this paper were made possible through the co-operative work of Firth Carpet Company. Much of the planning and actual sample preparation must be credited to Messrs Matthews and Schneeweis of Firth Carpet Company, and we sincerely appreciate the opportunity of working with these people toward the solution of a mutual problem.

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(2) Snell, F D, Snell, C and Reich, "Nature of Dirt and Methods of Retention at the Surface", *J Am Oil Chemists' Soc* 27, 62 (1950).

(3) Leonard, E A, "Combined Research about Location Cleaning Defines Important Factors", *National Rug Cleaner* 22, 16 (April, 1949).

(4) Masland, C H, "Soil Retention of Various Fibers", *Rayon Textile Monthly* 20, 573 and 654 (Oct and Nov, 1939).

(5) Compton, J and Hart, W V, "A New Approach to the Study of the Soiling and Soil Retention Properties of Textile Fibers", Prescribed at ACS Meeting, Division of Colloid Chemistry, 117th meeting, Houston, Texas (1950).

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REPORTS FROM THE LOCAL SECTIONS

Piedmont Section

THE Winter Meeting of the Piedmont Section was held at the Poinsett Hotel, Greenville, S C, on January 30, 1954. A research meeting was held in the morning with Edward A Murray presiding.

The afternoon technical session featured the following presentations:

"The Pigment-Binding Power of Textile Finishing Materials" by Leonard Shapiro, director of the Sales-Service Division, American Polymer Company of the Chemical Division of the Borden Company; and

"Looking Backward—Remarks on the History of Dyeing and Finishing" by Sidney M Edelstein, technical director, Dexter Chemical Corporation.

The invocation at the evening banquet was given by A R Thompson. Guest speaker was J W Beard of Anderson, S C.

Approximately 175 members and guests were in attendance.

NOTICE TO SECRETARIES AND PUBLICITY CHAIRMEN OF LOCAL SECTIONS

Papers presented before local sections should be sent to Dr Carl Z Draves, Editor of the *Proceedings*, 30 Lahey Street, New Hyde Park, New York. Authors should provide two copies for this purpose.

Reports of local section meetings should be sent to the American Dyestuff Reporter with copies going to Dr H C Chapin, National Secretary.

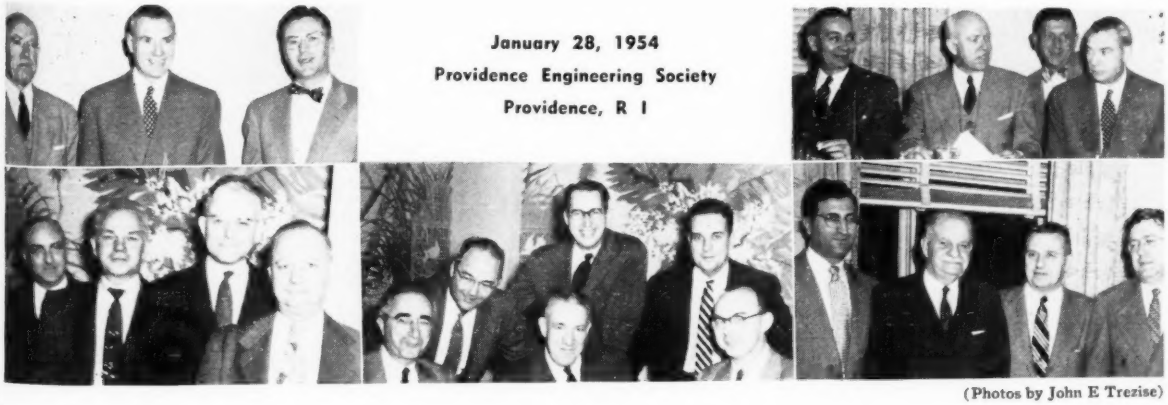
Dates of meetings and advance notices of meetings should be sent to the American Dyestuff Reporter with copies also going to Dr Chapin. For publication in any particular issue, information should be in the office of the Reporter 17 days before the issuance date.

Northern New England Section

THE Northern New England Section met at the Massachusetts Institute of Technology Faculty Club, Cambridge, Mass, on February 12 to hear Sidney M Edelstein, technical director of Dexter Chemical Corporation, and Newton D Teixeira, senior research associate of Fabric Research Laboratories, Inc give a talk on "A New Look at the Electrostatic Problem". The talk was illustrated with a demonstration of the measurement of one of the important electrostatic properties in fabrics by means of a newly developed machine.

AATCC President J Robert Bonnar was in attendance and extended greetings to the 111 members and guests in attendance.

Rhode Island Section Meeting Photos



January 28, 1954
Providence Engineering Society
Providence, R I

(Photos by John E Trezise)

Southeastern Section

THE Southeastern Section held its first meeting of the year at Talladega, Alabama, on January 16, with W O Bozeman, Russell Manufacturing Company in charge of the program.

The technical session held in the Alabama Power Company hall featured a talk by H C Borghetty, Rohm & Haas Company, on "Surfactants in Textile Processing". The session attracted approximately 100.

Dinner followed at the Purefoy Hotel.

Western New England Section

A meeting of the Western New England Section was held on Friday, January 29, 1954, at Rapp's Restaurant, Shelton, Connecticut. The technical program consisted of a talk on "The Technology of Wool Felt and the Textile Chemist," by Thomas J Gillick, Jr, American Felt Company. A sound motion picture in color entitled "The Miracle of Felt" was also shown.

Pacific Southwest Section

THE Pacific Southwest Section held a quarterly dinner meeting on January 29, 1954 at the Gourmet Restaurant in Beverly Hills.

As guest speaker, Joseph B Evans, vice-president and director of sales for the Dexter Chemical Corporation, addressed the thirty members and guests present on the subject "Buyer-Salesman Relationship." A question and answer period followed.

The minutes of the previous meeting were read and approved. Theodore Smock, Outing Committee Chairman, reported that 42 people, the largest attendance yet, participated in the Fifth Annual Outing of Ojai Valley Inn on October 10, 1953.

Sidney Springer, chairman, named the following as the nominating committee to propose a new slate of officers: Robert Mischell, Robert Fliegel, and Fred Wilhelm. Mr Mitchell moved that the present officers be continued in office for the coming year. Hubert O'Briant seconded and the motion passed.

New York Section

A MEETING of the New York Section was held at the Hotel Statler, New York, on Friday evening, January 29th, 1954. An informal dinner preceded the meeting.

Weldon G Helmus, Chairman, called attention to the fact that copies of the Vat Monograph were available for inspection and purchase. During the course of the meeting a number of copies were sold by Glenn D Jackson, Jr.

Dr Charles Weidmann, Technical Director of Ciba Company, Inc, presented a paper entitled "Neutral Premetallized Dyestuffs", which was illustrated by slides. A discussion period followed the presentation of the paper.

The attendance was about 175.

* * * *

The April meeting of the New York Section originally scheduled for the 23rd will be held on the 9th and the May meeting, originally scheduled for the 21st will be held on the 14th. Both meetings will be held at Kohler's Swiss Chalet, Rochelle Park, N J.

Western New England Section Meeting Photos

• PATENT DIGEST •

PAUL WENGRAF

DYEING DRY-SPUN ACRYLONITRILE FIBERS———Zinc Chloride Used C, 4, 07

U S Pat 2,636,802 (Chemstrand Corp——— Wesp, Ham——April 28, 1953)

Two methods for spinning acrylonitrile polymers are known: the "wet" method, which consists of extruding the spinning solution into water or another liquid, and the "dry" method, which uses air or another gas as the setting medium. Generally the dry method produces fibers of higher qualities (knot strength, density, softness), while at the same time facilitating the recovery of the expensive solvents.

Fibers spun by the "wet" method, however, are dyeable without difficulty in contrast to the dry spun material, which cannot readily be dyed by customary operations.

Obviously an alternate method for dyeing dry spun yarns would be most desirable. This is said to be attained by putting the fibers in contact with an aqueous zinc chloride solution under controlled conditions since the material might otherwise be attacked and dissolved in extreme cases. The reaction is difficult to understand since other solvents, such as lithium bromide, do not have the same dye-promoting effect. The dye-accepting property of the fiber surface is said to be retained even after zinc chloride is washed out provided the fibers are still in a wet state. After the fibers dry, however, this affinity is again lost, thus proving that no permanent physical change has taken place.

Concentrations of 45-81% (saturation point at 25° C), temperatures between 5 and 100° C, and time periods varying between a few seconds and 60 minutes can give good results according to the special circumstances. The optimum conditions have to be determined by practical experiments. Concentrations of 50-70% zinc chloride and temperatures between 30-60° C are reported as appropriate, but no figures can be offered for the best time of treatment. An examination of fiber condition during dyeing is necessary to obtain the best dyeing effect without loss of desirable physical properties.

Although this process is intended mainly for dry-spun acrylonitrile fibers (of a copolymer of at least 80% acrylonitrile and 20% or less of a vinyl monomer) this invention can also be usefully applied to wet-spun fibers; accordingly concentrations and temperatures will have to be lower in this event and shorter time periods in treating the yarns are suggested.

Examples call for dyeing with acid dyes (Acid Green GC Extra, C I 666, Xylene Fast Red P), with basic dyes (Victoria Green WB, C I 657), with sulfur dyes (Indocarbon CLGS, Pr 126), direct dyes (Trisulfon Brown BC, C I 561), etc. Satisfactory dyeings of the pretreated yarns are said to result while untreated fibers remain practically colorless.

Among the references cited by the Patent Office:

U S Pat 2,537,177 (American Viscose Corp/1951): dyeing vinyl- or vinylidene fibers with water-soluble acid dyes or direct dyes from solutions in water-miscible non-aqueous solvents, e g, Cellosolve, which have a fiber-swelling effect [cf *Am Dyestuff Reptr 40,* 357 (1951)].

U S Pat 2,512,969 (Du Pont/1950): acrylonitrile fibers are dyed with an acetate dyestuff and 1-5% meta-cresol by weight of the dyebath [cf *Am Dyestuff Reptr 39,* 766 (1950)].

U S Pat 2,404,727 and 2,404,714 (Du Pont/1946): quoting U S Pat 2,140,921 (Rein) according to which specification polyacrylonitrile can be dissolved in zinc chloride.

U S Pat 2,347,508 (Carbide and Carbon/1944): vinyl-resin fibers are dyed with acetate dyes, using as an assistant a solvent for the resin that is at least partly miscible with water.

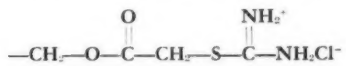
U S Pat 2,260,543 (Carbide & Carbon/1941): dyeing thermoplastic material with an organic dyestuff solution containing a solvent and a nonsolvent, thus exerting a limited solvent effect that penetrates but does not dissolve the material.

Attempts to dye the surface of acrylic polymer fibers in the presence of amines, phenols, etc, are disclosed in Brit P 576, 793 (Imperial Chemical Industries) [cf *Am Dyestuff Reptr 35,* 504 (1946)]; apparently inorganic salts, such as zinc chloride, had not yet been applied for this purpose.

DYEING CHLORINE-CONTAINING ACRYLIC FIBERS with Acid Dyes, Thiourea Added C, 4, 07

U S Pat 2,637,620 (Chemstrand Corp—— Ham——May 5, 1953)

Another way to dye acrylonitrile polymers is described in the present patent, which refers especially to prepared copolymers. Former applications filed by the same inventor disclosed that fibers of increased reactivity result by copolymerizing 80-95% acrylonitrile with 5-20% of an unsaturated ester of chlorocarboxylic acid, e g, allyl chloracetate, vinyl chloroacetate or methallyl chloroacetate. The chlorine-containing copolymer apparently reacts with thiourea forming the group:



The reacted fibers have pronounced affinity for acid dyes, the dyeings being fast to laundering and drycleaning. It is believed that salt formation between chlorine and thiourea takes place and that the ionic halogen is subsequently exchanged for the dye anion in the dyeing operation.

The present invention calls for further modification of the dyeing process by adding thiourea to the acid bath instead of first reacting it with the chlorine-containing copolymer fibers. In this event the fibrous material probably reacts in situ first with thiourea and then with the dye in a single step.

Examples refer to successful acid dyeings of the chlorine-containing filaments at 100° C with Wool Fast Scarlet (C I 252), with Alizarine Light Blue 4GL (Pr 485) and with Wool Fast Yellow in the presence of sulfuric acid and thiourea. A similar sample remained substantially undyed when thiourea was left out.

References cited by the Patent Office:

U S Pat 2,497,526 (Du Pont/1950): improving the dyeing properties of polyacrylonitrile fibers by a hydrazine treatment [cf *Am Dyestuff Reptr 39,* 467 (1950)]

U S Pat 2,332,899 (General Electric/1943) quite generally describes the synthesis of acetalized and/or ketalized vinyl esters or other unsaturated polymeric componds. These substances may be modified by a treatment with urea, thiourea and other compounds of this class, apparently with no change in dyeing properties.

SHRINKPROOFING WOOL———Alcoholic Caustic Combined with Formaldehyde Treatment A, 2, 04

Brit P 686,104 (Tootal Broadhurst Lee Co——Jan 21, 1953)

The felting and shrinkage of wool or other animal fibers may be prevented by a treatment with alcoholic caustic solutions. This method has been described in the Company's Brit P 538,396 and 538,428. A further modification of this process is disclosed in the same firm's Brit P 592,880 (1947) comprising a treatment with a ternary mixture of caustic alkali, alcohol and nonsolvent, such as trichloroethylene [cf *Am Dyestuff Reptr* 37, 697 (1948)].

It has been observed that the resistance to abrasion in wet state can be further improved by a treatment with formaldehyde before, during, or after the caustic alcoholic passage.

In pre- or aftertreatments formaldehyde is applied in acid solutions, preferably in the presence of sodium sulfate or another salt, to reduce the swelling properties of the protein fibers. Another method comprises a single bath method with alcohol-caustic-white spirit. In this case formaldehyde has to be added in solid form as paraformaldehyde and dissolved in the mixture to avoid any substantial water content (Example 9). In any event alkali adhering to the fiber has to be neutralized with acid, and this is followed by a treatment with bicarbonate.

Example: wool flannel was immersed in a solution obtained by diluting one vol of a 6% solution of NaOH in butanol with 9 vol white spirit. After excess liquid was removed the goods were neutralized with dilute sulfuric acid containing 5% of formaldehyde and 10% of anhydrous sodium sulfate. The dried fabrics were tried on the "Ring Wear" testing machine (described in the *1939 Textile Recorder Year Book* page H37) and gave the following results:

	Number of revolutions	
	dry test	*wet test*
Treated, sulfuric acid without formaldehyde	1224	416
Treated, sulfuric acid with formaldehyde	1820	2032
Untreated	2003	1220

Thus the treatment of animal fibers with formaldehyde and alcoholic caustic, each of these components known per se as shrinkproofing agents, proved to give superior results, especially insofar as imparting increased wet-abrasion resistance.

OFFSET PRINTING TEXTILES———Insoluble Basic Dyes in Water-Free Medium D, 2, 03

Brit P 686,231 (Messerli——Jan 21, 1953)

This patent refers to lithographic and offset printing methods for textiles wherein fatty binding agents, e g, linseed oil- or artificial resin varnishes, are applied as binders in contrast to standard methods using water-soluble thickeners or oil emulsions.

Basic dyestuffs preferred for bright shades cannot be used in offset printing. Although water-soluble basic dyes or their inorganic acid salts or (zinc) double salts are miscible with the aforementioned binders, they bleed strongly in rinsing because they are present in a water-soluble state. The same reportedly is true for the water-insoluble dyestuff bases, which bleed when the printing plates are moistened.

The inventor suggests the use of water-insoluble salts or dyestuff bases with higher carboxylic acids (containing a hydrocarbon chain over 6 C), for instance, those obtained by oxidizing paraffin wax or other fatty acids, such as caprylic, stearic, adipic acids and the like. It is assumed that these insoluble salts are split in steaming and liberate the free bases that are absorbed by the fibers (natural silk or rayon). This procedure is contrasted with the customary basic dye-tannin printing process where no splitting of the dye lake occurs.

The dyestuff base is melted with the carboxylic acid to effect salt formation and is then mixed with the varnish binder. After being printed in a flat press the fabrics are steamed for 0.5-1 hour and the excess of color and binder is removed by washing, soaping and optionally adding a dispersing agent.

Example: the fatty acid obtained by oxidizing brown coal paraffin is melted with the free base of Victoria Blue B (Schultz, Farbstofftabellen VII, #822) and warmed while being stirred until the dyestuff is dissolved. The mixture is brought to 130° C to make the reaction complete. The solidified product is comminuted to a fine powder and mixed with linseed oil varnish and some alumina hydrate. The printed and steamed fabric is soaped for a few minutes at 40° C, rinsed and dried. Deep blue prints result.

Apparently this method does not produce prints that are fast to prolonged soaping, but possibly it is sufficient for special styles. The inventor suggests that the fastness of the prints may be improved by preparing cotton or rayon with tannic acid and aftertreating with antimony salts (page 2, lines 20-25).

SHRINKPROOFING WOOL———Acid-Soluble Hydrophobic Melamine-Formaldehyde Condensates A, 2, 04

U S Pat 2,632,717 (Ciba Ltd——Landolt——March 24, 1953)

The inventor states that hydrophobic resins of the melamine-formaldehyde class which are soluble in concentrated acids and which may be precipitated by increasing the pH are known. It is also known that melamine condensates can be used for stabilizing vegetable fabrics and for shrinkproofing animal fibers.

According to the current invention an especially good shrinkproofing effect is obtained by treating wool material with an acid solution of hydrophobic melamine resin at a pH value near the point where precipitation occurs. This point of precipitation lies between pH 2.5-4.0 in solutions of 1-15%. Impregnating baths containing 50-100 p of the resin dissolved in 1000 p water are preferable.

Example: a hydrophobic melamine resin, of which a 10% solution in hydrochloric acid just fails to precipitate at pH 3, is dissolved in boiling water and this solution is poured into cold water plus formic acid. Wool is immersed in this bath for 15 minutes and dried. Good shrinkage resistance after soaping the goods may be observed. Although the baths should remain clear during impregnation it will be found that in some cases a better resistance to shrinking results when using liquids where some slight precipitation has taken place.

The most significant advantage appears to be that generally a hardening aftertreatment above 100° C can be omitted.

References cited by the Patent Office:

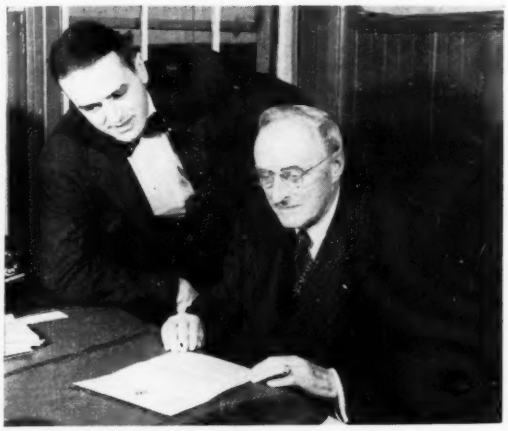
U S Pat 2,329,622 (American Cyanamid/1943): shrinkproofing wool with a water-dispersible, nonpolymerized alkylated melamine-formaldehyde condensate.

U S Pat 2,394,009 (American Cyanamid/1946): treating nonfibrous cellulosic bodies, especially films with acidic aqueous colloidal solutions of melamine-formaldehyde condensates, for further use as wrapping materials.

U S Pat 2,429,073 (Hat Corporation/1947): preparing cotton with acid melamine-formaldehyde condensates to make them more dyeable with acid dyes in mixtures with wool for felt manufacture.

NEWS

• W F Fancourt Co Celebrating 50th Anniversary



John Fancourt (left) and W F Fancourt, Jr.

Mr Fancourt chats with Claude Wolff, chief chemist.

COMMENTING on the W F Fancourt Company's first half-century of operations, W F Fancourt, Jr, president of the 50-year-old Philadelphia concern, states that "a golden anniversary is both an arrival and a departure . . . you arrive at 50 years in a business and depart for another 50."

Strictly a family concern, which began operations as a manufacturer of soaps in 1904, W F Fancourt is today a prominent supplier of a variety of textile chemicals.

Two points contributing to the company's success are the confidence of its customers and its continuous development of new, useful materials. In the words of Mr Fancourt, "that confidence is built on a personal service factor", which has been continuously in force. Mr Fancourt prides himself in having "never lost touch with his customers" and looks to his sons, Walter III and John, to carry on the tradition after his retirement.

W F Fancourt III

Walter III, a graduate of Philadelphia Textile Institute, holds the offices of vice president and general manager. He has been active with the Company for 21 years. John, a graduate of Pennsylvania Military College, holds the office of treasurer. His service with the firm totals nine years.

All three men have taken an active interest in various trade groups. Mr Fancourt is currently president of the Oil Trade Association. Walter III heads the Textile Chemical Manufacturers Association and Phi Psi, national textile fraternity. He is also prominent in the affairs of the Philadelphia Section, AATCC, having served as general chairman of the 1949 Convention in Atlantic City. In addition, the firm is a corporate member of AATCC.

To keep abreast of new product development while working on customer problems the Company operates, immediately adjacent to its executive offices, a modern, fully equipped laboratory.

Hosiery has always played a major role in Fancourt's business operations, and today represents the largest segment of its activity.

Originally one of the largest importers of olive oil for worsted spinning, the Fancourt concern was founded on October 1, 1904 at 70 North Water Street, Philadelphia. In 1908 the firm was incorporated and in August 1911 moved to its present location at 516 South Delaware Avenue, where it occupies a 4-story building.

Taking cognizance of the South's important role in the industry, the firm opened an office in Greensboro, N C, in 1937. The office, which was shifted to Burlington, N C last year, is under the direction of Thomas J Lindley.

THE TEXTILE MACHINERY EXHIBITION NUMBER
—AMERICAN DYESTUFF REPORTER—
WILL APPEAR ON APRIL 12, 1954

• Metro Licensed to Manufacture and Sell Bancroft Printing Inks

A license to manufacture and sell Joseph Bancroft & Sons Company's new line of printing inks has been granted Metro Dyestuff Corporation, a subsidiary of Metro-Atlantic, Inc, West Warwick, R I. The inks will be sold under the tradename of Emboprint E Series, to Everglaze licensees.

W R MacIntyre, Bancroft president, points out that the new formulations for color, announced a short time ago, make possible the production of 3-dimensional fabrics with inlay and tipped effects in a full range of colors. The shades are said to be exceptionally fast to laundering, drycleaning and light. They are being licensed for manufacture to afford Everglaze licensees a source of supply from which they can purchase the completely prepared color.

• Major Conference on Pollution

One of the largest conferences of experts on the problem of air and water pollution in America will be held in Houston, Texas, April 21-23.

The Manufacturing Chemists' Association, in place of its own regular annual technical conference on pollution, is joining with the Southern Association of Science and Industry and the Texas Chemical Council in sponsoring the gathering, to be known as the 1954 Southern Industrial Conference.

The following experts in the pollution abatement fields will participate in the program: William E Rand, research director for the Stanford Research Institute; Louis F Warrick, senior sanitary engineer for the United States Public Health Service; C K Banks, director of research for the Metal and Thermit Corporation; Clair N Sawyer, professor of sanitary chemistry, Massachusetts Institute of Technology; W J Cutbirth, Jr and D F Smallhorst, Texas pollution control directors; C M Shigley, director of research for the Texas Division of the Dow Chemical Company; H E Morris, director of research for the Texas Division of the Monsanto Chemical Company; and William H Weir, director of Water Pollution Control for the Georgia State Department of Public Health.

The mornings will be devoted to management level discussions of fundamental philosophy of pollution control and the afternoons will be taken up with more detailed discussions of pollution abatement know-how. Presiding officers will be A P Black, president of the Southern Association of Science and Industry; William C Foster, president of the Manufacturing Chemists' Association and J D Harper, president of the Texas Chemical Council. L L Hedgepeth of the American Cyanamid Company is Chairman of the Conference.

NAMES IN THE NEWS

R B Seymour

GEORGE L WIRTZ, who was recently promoted to chairman of the board, has announced the appointment of RAYMOND B SEYMOUR as president of the Atlas Mineral Products Company. Dr Seymour, the originator of furan cements and many of the other products of the Atlas line, joined the firm as chief chemist in 1939. Since 1949, he has been executive vice president and a member of the board of directors.

Dr Seymour is the third president of this 64-year-old firm. George L Wirtz, who has resigned as president, succeeded his father, the late Maximilian F Wirtz, founder and first president. JOSEPH A SNOOK will continue to serve as vice president in charge of sales and engineering. The board of directors consist of Mr Wirtz, Dr Seymour, Mr Snook and Daniel Lowenthal, partner in the firm of Fox, Rothschild, O'Brien and Frankel, Attorneys, Philadelphia, Pa.

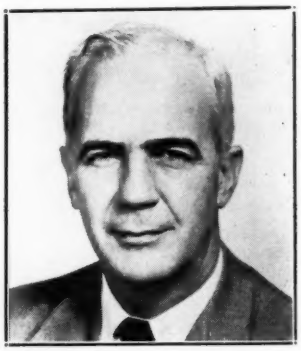
CORRECTION

YOUR attention is called to an error on page 60 of the January 18th issue, in which it was stated that Charles R Trommer had joined Colonial Piece Dye Works, Inc of North Bergen, N J. Mr Trommer has joined the staff of Colonial Print Works, Inc, Paterson, N J, as the plant dye chemist.

A J McCarthy

THE election of ALEXANDER J McCARTHY as secretary of National Adhesives Ltd, a subsidiary of National Starch Products Inc, New York, has been announced by the Directors of the company.

Mr McCarthy has been associated with National Adhesives Ltd, since 1947.



H H Cudd

HERSCHEL H CUDD has been appointed to a newly created position of manager of research and development by American Viscose Corporation. Dr Cudd has resigned as director of the Engineering Experiment Station at Georgia Institute of Technology and will occupy his new post effective April 1st.

In the new position, he will be responsible for the research and development activities of the various departments and pilot plants of the company and will have charge of coordinating and planning an expanded research program designed to improve present products and to develop new products.

ERNEST NATHAN has sold his interest in Metro-Atlantic Inc, of Centredale, R I, and has resigned as chairman of the board and treasurer. Mr Nathan's future plans will be announced later.

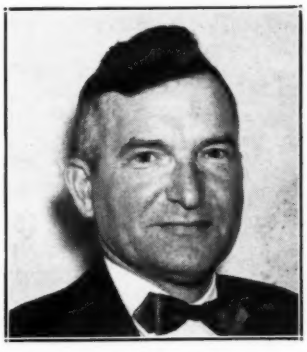
B W Henderson

F B Manker

R P Beaven

M N Gaboury

J D McPherson



W Milne

FOLLOWING a recent announcement of the reorganization of American Cyanamid Company's divisional structure, the Organic Chemicals Division has been formed to embrace the development, production, and sales of the products of the former Dyestuff, Textile Resin, Intermediate and Rubber Chemicals, and Explosives Departments of the Calco Chemical Division, and Petrochemicals Divisions.

L C Duncan, general manager of the new Division has announced the appointment of BANCROFT W HENDERSON as director of sales. Mr Henderson, who has been with Cyanamid since 1935, was formerly manager of the Intermediate & Rubber Chemicals Department of the Calco Chemical Division.

Other appointments of note in the far-flung Cyanamid organization are as follows:

M N GABOURY has been named plant manager, and F B MANKER, assistant plant manager, of the Bound Brook, N J, plant. Mr Gaboury moves up from the post of manager of the Color Department at the Bound Brook operation. Mr Manker was general superintendent of Canadian operations for the Barrett Company before moving to Bound Brook.

J D McPHERSON has been appointed manager of the Manufacturers Chemicals Department, moving up from the post of technical director and assistant manager.

L K MAYNE and KENNETH K DANTON have been named managers at the Woodbridge, N J, plant of the Industrial Chemicals Division and Azusa, Calif, plants, respectively. Mr Mayne had been manager of small plant operations for the ICD before this latest appointment, while Mr Danton was formerly general production superintendent at the Bridgeville, Pa, plant. Mr Danton replaces W N OLDHAM, who has been assigned to the newly created post of technical director of the Wallingford, Conn, plant.

D H W FELCH is Cyanamid's new Far Eastern representative. His headquarters will be in Tokyo.

WILLIAM L DAVIDSON has been appointed a full time consultant to Food Machinery and Chemical Corporation.

Dr Davidson until January 1 of this year had been Director of the Office of Industrial Development of the United States Atomic Energy Commission in charge of disseminating to industry AEC technical data of importance to industrial research and development.

CHESTER J PETKIEWICZ has been awarded the first scholarship at Lowell Technological Institute to be awarded by the Interchemical Corporation. The scholarship was established for award to a member of the junior class majoring in chemistry on the basis of scholastic achievement, character, and leadership potential.

THE Rumford Chemical Works, Rumford, R I, has announced the appointment of ROBERT P BEAVEN to the position of Chemical Division sales manager, and the addition of WILLIAM MILNE to the sales staff.

Mr Beaven joined Rumford as a salesman in 1947, while Mr Milne has served the company for some time as a textile consultant.

SIXTEEN sales engineers were recently added to the field sales force of Minneapolis-Honeywell Regulator Company's Industrial Division in 12 branch offices.

At the same time it was reported that 20 service engineers were also added to the firm's field sales force taking assignments in 17 U S cities and two Canadian cities.

The new appointees, all graduates from the company's industrial instrument training school in Philadelphia, include: K J LESKER, Dallas; O E KRIENKE, New Jersey; W J BOSCHERT, St Louis; W G HENDERSON, Chicago; R P NORTON, Indianapolis; W J YOUNG, Houston; W C CURP, Dayton; W T LISENBY and J T GENTRY, Los Angeles; J L CIPRARI, Minneapolis; K BATCHELOR, Houston; W L BOLTON, Atlanta; R J RAYCROFT, Toronto; T M HUNT and W F HARRISON, Montreal, and H E ALLISON, International Division.

W Dietrich

W H Hindle

E S Underwood

ON APRIL 1, WERNER DIETRICH, chemist of Badische Anilin- & Soda-Fabrik A G, Ludwigshafen am Rhein, Germany, will be celebrating his 25th anniversary of continuous service with the dyestuff industry.

Dr Dietrich was born in 1903 in Leipzig. He studied at the University of Leipzig and obtained the doctor's degree with a thesis on dyestuff intermediates. After entering the service of the I G Farbenindustrie A G in 1929, he worked first in the Dyestuff Testing Laboratory of the Coloristic Dept at Ludwigshafen am Rhein, then in the I G works at Leverkusen, where he was trained in the application aspects of textile dyestuffs. From 1936 until 1938 he worked in sales offices.

In 1938 he was appointed technical adviser to the administrative office of the I G Farbenindustrie A G, Frankfurt a M (Grüneburg), for the export of textile processing products to the Far East. At the end of World War II, he returned to Badische Anilin- & Soda-Fabrik, where he was appointed head of the Cotton Dyeing Section of the Application Techniques Dept.

It was through the broad experience of Dr Dietrich that the Colloisol brands of BASF vat colors, particularly "active" fine powder brands for continuous dyeing, were developed.

Dr Dietrich is a member of the AATCC, the VTTC and the Svenska Fargeritekniska Riksförbundet.

CARL W WEBER has been appointed sales assistant in the Chemical Division of General Mills, Inc. He will be responsible for office operations of the division's sales department at Kankakee, Ill.

JOHN J BRESS has joined the Product Development Department of the Chemical Division of Celanese Corporation of America as technical service engineer. He is attached to the Application Laboratory of the Division at Summit, N J, and will work with vinyl acetate emulsion paint formulations.

WALTER H HINDLE has been named associate director of research in charge of the newly created Dyeing and Finishing Section of the Research department for The Chemstrand Corporation, Decatur, Ala.

Prior to joining Chemstrand Mr Hindle was in direct charge of the dyeing and finishing research and development department of Burlington Mills Corporation at Greensboro, North Carolina.

FOUR departments are directly affected by the following recent personnel moves on the part of General Electric Company:

Chemical Materials Department——HARRY S KOMER has been named superintendent of the Anaheim, Calif, plant, where he will also continue to serve as supervisor of finance, and BOYETTE EDWARDS, JR, has been made supervisor of industrial engineering for the Phenolic Products Plant, Pittsfield, Mass.

Engineering Department——FREDERIC W HAMMESFAHR has been named manager — chemical process development section, with headquarters in Pittsfield.

Silicone Products Department——JOHN T CASTLES, formerly manager of the Waterford, N Y, plant, has been named manager — technical service unit, marketing section, where he will report to MARK W HOWLETT.

Trumbull Components Department——A P McGRAW has been made manager — component sales; J D HOPKINS, manager — product planning and marketing research; J A KELLY, manager — commercial service; and H S HILL, manager — internal sales.

WARREN C LOTHROP has been appointed a vice president of Arthur D Little, Inc, Cambridge, Mass, where he will be in charge of the research and development division. This division, which includes the industrial chemistry, chemical research, and physics activities of the company's operations, will be housed in the new 60,000-square foot laboratory now being completed in West Cambridge. Mr Lothrop has been with the firm since 1946.

ES UNDERWOOD has joined the San Francisco, Calif, sales office of General Dyestuff Corporation, located at 37 Clementina Street, as sales representative for the Antara Chemicals Division of the company.

ALLIED CHEMICAL & DYE CORPORATION advises of the following personnel moves in three of its Divisions:

National Aniline Division——SAMUEL A COOPER has been named manager of the Synthetic Fiber Technical Service Department, where he will be responsible for mill-application service in connection with Allied's nylon-type fiber soon to be produced at Hopewell, Va. Mr Cooper has been a vice president of M Salzberg & Sons for the past seven years. DONALD M GOERG, who has joined the Division as a technical service representative, will also be concerned with mill-application techniques in connection with the new fiber.

Solvay Process Division——D O YOEMAN, director of development for the past 8 years, has retired after approximately 41 years with the Division. During the post-war years, Mr Yoeman directed the most extensive expansion and rehabilitation program in Solvay's history.

Barrett Division——CARLETON ELLIS, JR, was recently named director of sales for all Plaskon products. SAM GURLEY, formerly Barrett resin sales manager, is now general sales manager. H W DeVORE is manager of molding compound sales, H A RAYMOND, JR, is manager of industrial sales, and C D DELANEY is manager of coating resin sales. ROBERT K WHITE has been appointed advertising manager for Plaskon plastics and resins.

ARMAND BRANDAO, formerly with Noyes-Gebbard of Taunton, Mass, for 25 years, has joined the supervisory staff of Wamesit Wool Processing Co, Wamesit, Mass.

Mr Brandao, having extensive experience in carpet stocks, will be superintendent in charge of blending and head a new department that will cater exclusively to carpet manufacturers.

O P Beckwith

OLIVER P BECKWITH has joined Fabric Research Laboratories, Inc, Boston, Massachusetts, as a staff member. He was formerly director of quality control and chief of the Product Engineering Laboratories for Alexander Smith & Sons Carpet Company, Inc, Yonkers, New York.

It was pointed out that Mr Beckwith will be in charge of a newly created quality control group, the purpose of which is to provide a consulting service in the field of quality control to industry. Plant surveys of quality performance, development and installation of quality control procedures and organization, and consultation on specific quality problems will constitute the general area of this group's activity.

HERBERT B WOODMAN, president of Interchemical Corporation, will serve for the seventh consecutive year as chairman of the Paints and Chemicals Division of The Legal Aid Society's annual fund-raising campaign. Mr Woodman will be assisted by LAWRENCE A COLEMAN, ROBERT B FISKE, ROBERT C PORTER, and T F DAVIES HAYNES.

AO ZOSS, technical manager of the Linden plant, General Aniline & Film Corporation, served as discussion leader at a three-day American Management Association Workshop Seminar conducted in the McGraw-Hill Building, New York, N Y, recently.

Dr Zoss led a group made up of executives representing a cross-section of American business management, who discussed the "Organization of the Manufacturing Executive's Job." The subject matter included, among other things, a determination of the major functions of the manufacturing executive; his overall responsibilities and authority; operations and activities; organization, personnel and finances of his division; development of the "product line" and the integration of production activities, and the importance of using sound management principles, skills and tools.

J Platner

APPOINTMENT of JOHN PLATNER to The Goodyear Tire & Rubber Company's Chemical Division at Akron, O, has been announced. In his new assignment, Mr Platner will provide technical service to paint, paper and textile industries throughout the country.

ROBERTSHAW-FULTON Controls Company has announced the appointment of THOMAS H JEFFERS to the new position of assistant general manager of the Anaheim Division, Anaheim, Calif, and his election as an assistant vice president of the company. T T ARDEN continues as general manager of the Division. Mr Jeffers was formerly chief engineer at Anaheim.

ROBERT O'HARA has been added to the staff of the Detroit office of the company's Fielden Instrument Division. He was formerly on the staff of the Application Engineering Department at the Fielden office and factory in Philadelphia.

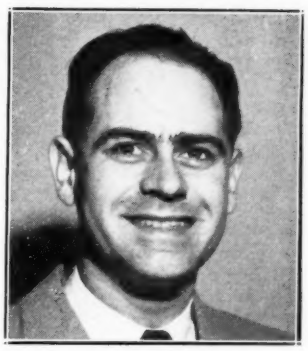
JOSEPH C McCARTHY has been appointed Canadian sales representative for the company's Robertshaw Thermostat, American Thermostat and Grayson Divisions. Mr McCarthy was formerly with Consumers' Gas Company and John Inglis Company, Ltd, of Toronto.

RECENT changes in the Industrial Chemicals sales organization of Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation, have been announced as follows:

R M JOSLIN, who was Central Division sales manager located in Chicago, has been appointed assistant sales manager, Industrial Chemicals. Mr Joslin will assume his duties shortly in the New York office of the Company.

E R YOUNG succeeds Mr Joslin as Central Division sales manager, but will supervise the Division from Carbide's offices in Cleveland, Ohio.

W M ANDERSON and R G METZ have been appointed district sales managers of the Cleveland and Indianapolis district sales offices, respectively.



R F Welter

RF WELTER has joined the New York Direct Sales Group of Antara Chemicals, sales division of General Aniline & Film Corporation, where he will assist in the sales program for chemical intermediates and carbonyl iron powder.

PHILLIP NATHANSON has joined the Lurex Division of The Dobeckmun Co, Cleveland, O, to head up a newly created research and development department. The new department has been set up for the dual projects of 1) developing and expanding the use of Lurex metallic textile yarns through the creation of experimental fabrics for all end-uses, and 2) ironing out any technical difficulties which might arise among established users.

The new unit will make its headquarters at The Dobeckmun's Co's offices at 250 West 57th Street, New York.

RW HOOKER, vice president of Hooker Electrochemical Co, Niagara Falls, N Y, was reelected to his sixth consecutive term as president of The Chlorine Institute Inc, at its annual meeting in New York recently. LOUIS NEUBERG, vice president of Westvaco Chlor-Alkali Division of Food Machinery and Chemical Corp, was reelected vice president. ROBERT T BALDWIN was reelected secretary-treasurer.

The Chlorine Institute has promoted safety in the packaging, transportation and use of chlorine since 1924.

DEAN M LEWIS, secretary and treasurer, Colonial Piece Dye Works, North Bergen, N J and HORACE T GREENWOOD, SR, president, Globe Dye Works, Philadelphia Pa, were inducted as honorary members in Phi Psi Fraternity, Alpha Chapter Philadelphia Textile Institute on February 15th at the Fraternity's Annual Founder's Day Banquet.

Mr Lewis is president of the Silk and Rayon Printers and Dyers Association of America while Mr Greenwood is a member of the Board of Governors of PTI.

BUFFALO Electro-Chemical Company, Inc, division of Food Machinery and Chemical Corporation has announced the appointment of VERNON E MOORE as Becco Sales Corporation's California sales representative with headquarters in Los Angeles. In addition to servicing the California area, Mr Moore will also serve Nevada and Arizona.

Mr Moore has been with the Becco organization for the last year, and previous to that, with Mathieson Chemical Corporation.

ANSUL CHEMICAL COMPANY, Marinette, Wis, has named TOM CHRISTIANSON as pilot plant manager and head of its Fine Chemicals Department, and RICHARD M BAKER as advertising and sales promition manager.

Mr Christianson, with Ansul since 1945, formerly was assistant production manager in the Chemical Division, while Mr Baker has spent his last six years with the company as publicity manager. BRAD SEBSTAD succeeds Mr Baker to the latter post.

ROBERT S KENYON of Fall River, Mass has been selected to study at the Institute of Textile Technology under a 2-year graduate fellowship in textile chemistry. The grant is under the auspices of Monsanto Chemical Co.

THE following promotions on Hooker Electrochemical Company's sales staff have been announced by R E Wilkin, vice president and general sales manager:

HAROLD A WEVER, who entered Hooker's employ in 1943, is now a field salesman with headquarters in Chicago; JULIAN J BOYCE, who most recently had been in the sales office at Niagara Falls, has been made a field salesman with headquarters in the Philadelphia area; and ERNEST F BLEW has become a field salesman with headquarters in New York. CHARLES A STRACK replaces Mr Blew in field technical sales service work from the Niagara Falls headquarters, and MATTHEW MEKJEAN replaces Mr Strack in the Virgo descaling salt laboratory.

As previously noted, SAMUEL J NELSON, JOHN E WEIR and FRANK W LONG, chemists, have been added to Hooker's resins and plastics group of the research and development department. Dr Nelson came to Hooker from the Research Laboratories of Atlantic Refining Co; Mr Weir, from the Organic Plastics Section of the NBS; and Mr Long, from the Textile Dyeing & Finishing Laboratory of the Philadelphia Quartermaster Depot. A previous announcement in the Reporter did not correctly list the most recent affiliations of Dr Nelson and Mr Long.

CALENDAR OF COMING EVENTS

AMERICAN CHEMICAL SOCIETY
National Chemical Exposition—Oct 12-15, Chicago, Ill.

AMERICAN MANAGEMENT ASSOCIATION
23rd National Packaging Exposition—April 5-8, Convention Hall, Atlantic City, N J.

AMERICAN SOCIETY FOR QUALITY CONTROL
Meeting of the Carolinas Section—April 2, Clemson, S C.
Conference of the Carolinas, Georgia, Tennessee, Birmingham and Huntsville Sections—Nov 5-7, Chattanooga, Tenn.

AMERICAN SOCIETY FOR TESTING MATERIALS
Committee D-13 (Textile Materials)—Mar 17-19, Hotel Statler, New York, N Y.
Annual Meeting—June 13-18, Sherman and Morrison Hotels, Chicago, Ill.

AMERICAN TEXTILE MACHINERY ASSOCIATION
Exhibit of American Textile Machinery, April 26-May 1, Atlantic City Exhibition Hall, Atlantic City, N J.

CANADIAN ASSOCIATION OF TEXTILE CHEMISTS AND COLOURISTS
Meetings of the Quebec Section—Mar 20, April 23-24 (Montreal, Que); June 19 (Annual Golf Tournament).

CHAMBRE SYNDICALE TRAMAGRAS
International Detergent Congress—Aug 30-Sept 5, The Sorbonne, Paris, France.

DELTA KAPPA PHI FRATERNITY
1954 National Convention—April 2-3, Raleigh, N C.

DRYSALTERS CLUB OF NEW ENGLAND
April 30 (Hotel Vendome, Boston); June 25 (Annual Outing, Andover Country Club).

THE FIBER SOCIETY
Spring Meeting—May 5-6, Monticello Hotel and Thomas Jefferson Inn, Charlottesville, Va.
Fall Meeting—Sept 13-14, McGill University, Montreal, Canada.

INTERNATIONAL CONGRESS OF MAN-MADE FIBERS
May 31-June 3, Paris, France

LOWELL TECHNOLOGICAL INSTITUTE ALUMNI ASSOCIATION
Annual Reunion—April 28, Haddon Hall, Atlantic City, N J.

MANUFACTURING CHEMISTS ASSOCIATION, SOUTHERN ASSOCIATION OF SCIENCE AND INDUSTRY; and TEXAS CHEMICAL COUNCIL
1954 Southern Industrial Conference—April 21-23, Houston, Texas.

NEW YORK BOARD OF TRADE (DCAT)
28th Annual Dinner, March 4 (Waldorf-Astoria, New York, N Y).

SOCIETY OF CHEMICAL INDUSTRY
Plastics and Polymers Group Meeting—March 24-26, Institution of Electrical Engineers, Savoy Place, London, England.

SOUTHERN MUNICIPAL AND INDUSTRIAL WASTE CONFERENCE
Third Annual Conference—March 18-19, N C State College, Raleigh, N C.

SOUTHERN TEXTILE EXPOSITION
October 4-9 (Textile Hall, Greenville, S C).

TEXTILE TECHNICAL FEDERATION OF CANADA
Exhibit—April, 1955, Show Mart, Montreal.

BOOK REVIEWS

MALEIC ANHYDRIDE DERIVATIVES——— REACTIONS OF THE DOUBLE BOND

Lawrence H Flett and William Howlett Gardner
John Wiley and Sons, Inc
New York, N Y (1952)
$6.50; x and 269 pages

Maleic anhydride, derived from the catalytic oxidation of benzene, is used in the production of different types of alkyd resins, of maleinized drying oils, and of various copolymers. It is also used in the manufacture of organic pigments, rubber, demulsifying oils, oil additives, pharmaceuticals, tanning agents, detergents, wetting agents, abrasives, adhesives, cellophane and other technical products.

The authors have gathered together characteristic reactions of the maleyl group in a simple fashion, which is as they say "much as one might review a series of reference cards". On one side of the page is a brief description of how a product is made; on the facing page an equally brief account of what the product is like and their uses is given. A series of references is given with each reaction, and this feature alone may be of extreme value to the purchaser.

This is without a doubt a book intended for the research worker, student, and industrial chemist.—VL.

CASE HISTORIES IN COMMERCIAL DEVELOPMENT

John E Ullman
Chemonomics, Inc
New York, N Y
$5.00; 134 pp

Case histories of such chemicals and chemical products as Aerosols, Krilium, Orlon, Vicara, Electrolytic Chlorine and Alkali, Formica, Calgon and Coca-Cola are presented. The collection consists of brief descriptions of the methods by which many products from the chemical process industries have been developed, tested, and then placed on the market. Of particular interest to this reviewer were the case histories of the development of Orlon, Vicara and Orlon; although the histories are not extensive they are pretty much to the point. This little book should prove stimulating to those interested in the beginning of some of our large and growing chemical industries, and well worth the reading.—VL.

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